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NYASALAND PROTECTORATE

Annual Report

of the

Department of Agriculture

1930

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Report of the Director of Agriculture for 1930.

PART I. AGRICULTURE IN NYASALAND.

General.—The year under review has been a difficult one for all producers. Prices have continued to fall and the production of certain crops has been distinctly unremunerative. The general depression has held up much agricultural development that is waiting to be taken in hand. It has done good in directing increased attention to the necessity for the highest quality in the products of the country; at the same time, it has prohibited the adoption of lines of work which would lead to improvements in quality. It has led to a certain restriction of the areas under European agriculture, particularly in Central Shire where coffee and tobacco have been given up. The following figures of European acreages for 1929 and 1930 show a distinct decrease in the areas under tobacco, cotton, coffee, and miscellaneous crops, and they indicate the directions in which present conditions are having a restrictive effect on actual planting.

	1929 Acres.	1930 Acres.
Tobacco	19,269	17,481
Cotton	1,219	761
Coffee	1,331	1,256
Sisal	8,270	9,296
Rubber	1,330	1,405
Tea	8,866	9,686
Miscellaneous	19,892	15,373

A comparison of the figures of amounts exported and local values of the five principal crops of the country for 1929 and 1930 will show that tobacco alone has succeeded in showing an increase of value commensurate with the increase in production in 1930 whereas cotton, sisal, tea and coffee fail to show increases in value corresponding to increases of export. The position of cotton, sisal and tea is precarious and it is no surprise that efforts to effect economy in working should be necessary.

	1929 Tons	1929 Values	1930 Tons	1930 Values
Tobacco ...	5,400	£478,060	5,775	£484,738
Cotton ...	947	62,660	1,696	72,881
Sisal ...	1,200	34,464	1,284	29,607
Tea ...	784	74,382	866	56,543
Coffee ...	44	3,239	48	3,109

On the whole climatic conditions were favourable during the year although the rainfall was below normal. Periods of drought occurred at the lower elevations of the country and cold snaps were encountered in February but there was no lasting bad effect on crops in general and native food crops in particular.

Tobacco.—At the beginning of the season growing conditions were good. Rains in January, cold weather in February and a dry March retarded growth for a time, and an improvement in conditions led to vigorous growth at the wrong time and to much second growth which in turn led to the harvesting of tobacco which would not cure. Body was good on the whole but much green and perished tobacco was turned out. Tobacco which remained in the field, however, gave desirable leaf and, on the whole, the dark-fired tobacco was of good quality. The experience gained in what was an exceptional year should enable growers to avoid in the future the mistakes made in their harvesting and curing and should therefore be of value. Only a small quantity of inferior leaf was left in the hands of native growers. Tobacco from the Southern Province (Mlanje) was favourably reported on by Messrs. Frank Watson and Company but the shortage of wrappers was noted. Elsewhere in the Southern Province quality was deficient. Attention is being given to seed supply and the tuition of native growers.

The figures of acreages under European tobacco and yields therefrom are given by districts in annexure G. The total acreage (17,481) shows a decrease of 1,788 acres from 1929, and the total production of 1930 (58,114 cwt.) shows an increase of over 12,000 cwt. This state of affairs seems to point to a favourable season, improved cultivation and the use of improved seed. On the other hand, low prices have curtailed field improvements such as ridge terracing for conservation of soil and green and artificial manuring for maintenance of fertility. Ridge terracing in particular is deserving of encouragement and wider application. The cost is not excessive, and it should be remembered that money spent on rotations and on fertilizers may be wasted if efforts are not made to control or prevent soil erosion. There is also a tendency to apply concentrated fertilisers the use of which is not necessarily good farming. In certain years deficiencies of elements not contained in concentrated substances may lead to sulphur and magnesia starvation and thus to reduced yields and inferior quality. A note of warning may also be issued with regard to the slope of land used for tobacco. Fields of a slope of 1 in 7 have been planted in tobacco whereas a slope of 1 in 10 is considered the absolute limit. Erosion on a steep slope can and does easily become a headlong process of destruction.

The supply of tobacco seed is not wholly satisfactory. Seed which was supposed to be pure has been found in the field to give a mixture of different varieties and there is therefore need for great care in the selection of seed, particularly that which is sold to native growers. The Department of Agriculture has concentrated in the last few years on the *Western*, *Cash* and *Gold Leaf* varieties of tobacco. It is considered proved for Nyasaland conditions that these varieties can be kept constant in leaf size and characters by careful seed selection, and there is no doubt that the elimination of certain varieties which were grown only a few years ago has helped the grower to provide for the buyer and manufacturer a leaf of definite type and quality year after year. This desirable policy will be continued, and it is hoped to back it up by genetical and other investigational work for which plans have been prepared and which will be made possible by additions to the staff of the Department of Agriculture.

In 1930 native-grown tobacco was purchased in the amounts noted below under districts.

Cholo	...	66 tons	South Nyasa	...	1½ tons
Mlanje	...	213 ,,	Ncheu ...	...	41 ,,
Blantyre	...	197 ,,	Dedza ...	...	152 ,,
Chiradzulu	...	457 ,,	Fort Manning	...	26 ,,
Zomba	...	175 ,,	Lilongwe ...	...	1,762 ,,
Upper Shire	...	½ ,,	Dowa ...	...	962 ,,
			Kota Kota ...	...	180 ,,

The total native production of tobacco was 4,233 tons, an increase of 352 tons over 1929. Of this total 2,943 tons were produced in the Central Province, 933 tons in the Southern Province, 177 tons in the Zomba Province and 180 tons in the Northern Province. The number of registered native growers was 48,419 against 47,578 in 1929. The Central Province provided 29,077 growers and the other areas a total of 19,342.

The Native Tobacco Board continued its operations in the Central Province. At the end of the year the European field staff consisted of an Agent, two Area Supervisors and ten Supervisors, an increase of five in the number of Supervisors in the field.. The native field capitaos numbered 215. A certain amount of reorganisation was carried out and the duties of the officers of the Board were clearly defined. The issue of seed of a single type to native growers was controlled and every effort is being made to provide the best possible supervision of and tuition in the cultivation, harvesting and curing of the tobacco. During the year it was decided to institute a scheme by which tobacco would be graded under the auspices of the Board before being taken to the Central Buying Stations for sale; details have been worked out and plans made to put the scheme into operation during the 1931 buying season. Its aim is the improvement of quality, and it is hoped that it will ensure to the grower the best possible price and introduce him to an idea of the varying values of different grades of leaf and of the supreme value of quality.

The attention of the Native Tobacco Board was directed to certain defects in the legislation which controls the native industry and various matters were taken to Government after being discussed by the Board. The institution of Central Buying Stations by the Board was noted in last year's report and the following figures of tobacco sold in the Central Buying Stations in 1930 may be of interest.

Central Buying Station.		1929	1930	Increase	Decrease
Nathenje	...	695,275 lb	578,333 lb	—	116,942 lb
Maunda	...	1,085,239 ,,	985,410 ,,	—	99,829 ,,
Mponela	...	1,195,399 ,,	1,473,426 ,,	278,027 lb	—
Lombadzi	...	948,224 ,,	1,097,230 ,,	149,006 ,,	—
Malenga	...	—	402,015 ,,	402,015 ,,	—
Kalolo	...	280,030 ,,	416,080 ,,	136,050 ,,	—
Lingadzi	...	877,945 ,,	505,065 ,,	—	372,880 ,,
Mudi	...	286,775 ,,	357,806 ,,	71,031 ,,	—
Ngara	...	145,694 ,,	80,192 ,,	—	65,502 ,,
		5,514,581 ,,	5,895,557 ,,	1,036,129 ,,	655,153 ,,

The increase in sales in 1930 was thus 380,976 lb. The total number of buying booths was 108 and the number of buyers, individuals and firms, was 20. It was estimated that the principals paid £5,000 in salaries and commission to their buying agents and that £92,180 was disbursed in the Central Province in the form of purchases of tobacco, cost of erection of sheds, payment of local labour, capitaos and watchmen, and local purchases of native produce and meat. The buying of the Crown land crop alone cost £85,976 (estimated at 3½d. per lb.) and to this sum should be added the further sum of £9,469 paid for tobacco grown by native tenants. The transport of the crop cost over £30,000 and other items of expense such as licence and forestry fees, plot rents, cost of grading, handling and packing, and payment of tax on bought leaf amounted to over £38,000. The 1930 tobacco season in the Central Province therefore caused the circulation of about £177,000.

The income of the Native Tobacco Board for 1930 was £11,762 : 1 : 4 and the expenditure £11,022 : 18 : 5.

Cotton.—It will be seen from the figures of annexure G. that European-grown cotton occupied only 761 acres and gave a yield of lint amounting to 635 cwt. The corresponding figures for 1929 were 1,219 acres and 738 cwt. Native production of seed cotton amounted to 5,448 tons against 3,505 tons in 1929, an increase of 55 per cent. About six-sevenths of the

total amount was produced on the Lower River where conditions are favourable to cotton. The 1929 and 1930 figures of production by districts of native-grown seed cotton are as follows.

	1929	1930
Lower Shire ...	1,809 tons	2,315 tons
Chikwawa ...	1,248 ,,	2,418 ,,
Central Shire ...	195 ,,	266 ,,
Mlanje ...	14 ,,	28 ,,
Blantyre ...	10 ,,	44 ,,
Upper Shire ...	18 ,,	24 ,,
South Nyasa ...	18 ,,	26 ,,
Ncheu ...	47 ,,	58 ,,
Dedza ...	51 ,,	122 ,,
Dowa ...	95 ,,	86 ,,
Kota Kota ...	nil	nil
Karonga ...	nil	61 ,,

The increase in production has been accompanied by an increase in the proportion of first-grade cotton as is shown by the following figures which have been supplied by the British Cotton Growing Association.

	Seed cotton produced.	Percentages of grades.		
		1st	2nd	3rd
1926 ...	2,197 tons ...	66.84 ...	21.05 ...	12.11
1927 ...	1,387 ,, ...	78.14 ...	19.43 ...	2.43
1928 ...	2,486 ,, ...	87.86 ...	10.72 ...	1.42
1929 ...	3,505 ,, ...	86.46 ...	11.23 ...	2.31
1930 ...	5,448 ,, ...	88.61 ...	10.61 ...	.78

The 1930 season was therefore a good one. The increase of yield was largely due to planting date propaganda which was based on the results of experimental work and to the success of *Over-the-top* in up-country areas. The variety known as *U4* is promising well (bulk sowing of *U4* at Makwapala gave 197 lb. lint per acre), and, although *Cambodia* may ultimately prove more suitable for Lower Shire and Chikwawa, the mixed bulk *U4* grown at the stations of the Empire Cotton Growing Corporation seems to be all that the country requires. Arangements are in hand to have mixed bulk *U4* in general distribution in 1933 provided conditions and further experience of the behaviour of *U4* justify it.

Prices were low in 1930 and native growers were not slow to express disappointment. It is hoped, however, that increases of yields through improved seed and of the percentage of first-grade cotton have compensated the grower to some extent for low prices, and it is worthy of note that the amount of seed taken for the 1931 crop promises a larger production than may have been expected. With the exception of the cotton in the Karonga area, the crop was bought by the British Cotton Growing Association which exported 1,645 tons of native-grown lint. On account of low prices cotton production in the Karonga area in 1931 has not been encouraged in spite of the fact that the district was re-opened for cotton growing only in 1930 after a five years' close season caused by pink bollworm.

The prices paid by the British Cotton Growing Association were ¾d and 1d for No. 1, ⅝d and ⅝d for No. 2 and ½d and ½d for No. 3 grade per lb. of seed cotton and a total of £46,517 was disbursed by the Association in the purchase of the native crop. This figure represents a decrease of £14,624 over 1929. In North Nyasa where the British Cotton Growing Association do not buy, the African Lakes Corporation and Mr. Maxwell purchased at an all-round price of 1d per lb.

Tea.—Tea growing is entirely in the hands of European agriculturists. The acreage increased from 8,866 in 1929 to 9,686 in 1930 and production from 778 to 850 tons. The cultivation of tea is extending in the Cholo district and five new factories are expected to be built in 1931. In Mlanje the 1930 crop was good. Prices, however, were low and there seems little doubt that, apart altogether from the present depression, there is need to raise the standard of quality of Nyasaland tea. It is therefore gratifying to find an increasing interest in shade trees and green manures and in the various factory processes from withering to firing and grading. There has been a general adoption of ridge terracing as a measure of soil conservation and it is estimated that 85 per cent. of the tea land of the Protectorate has been so treated. Excellent work in soil conservation has been done in new clearings for young tea and in contour terracing, and it is hoped that the up-to-date methods of certain tea planters will be copied by others.

It is proposed to institute a Tea Experimental Station in the Mlanje district under the auspices of the Department of Agriculture. The Tea Research Association appointed an Advisory Committee for consultation with the officers of the Department of Agriculture and a suitable piece of land for the proposed station has been chosen. Plans of work for the station include investigation of the maintenance of soil moisture and fertility, of shade, green manure and ground cover plants, and of the manuring of tea, and it is intended that the officer in charge of the station shall become in time the advisory authority on local tea growing and manufacture.

Reference to the work of the Mycologist who is stationed for the present in the tea area will be found in annexure E. and on page 9.

Coffee.—The year 1930 saw a decrease of the acreage under coffee from 1,331 to 1,256 acres. Production increased from 58 tons in 1929 to 64 tons in 1930 but the value of the produce fell off. On the whole, cultivation of *arabica* coffee by Europeans and *robusta* coffee by natives is to be encouraged, and the Department of Agriculture hopes to institute before long experimental coffee plots in different districts on which there will be investigated or demonstrated shade, green manuring, ground cover plants, methods of conservation of soil and soil moisture, pruning systems

and control of pests. It is proposed to begin work with the varieties of coffee which are already in the country. In this connection attention may be drawn to the mention of coffee leaf disease (*Hemileia vastatrix*) in Nyasaland in the report of the Mycologist (annexure E.)

Sisal.—1930 has been an unremunerative year for producers of sisal. The acreage at the end of the year was 9,296 and production amounted to 26,106 cwt., the former being an increase of 1,026 acres and the latter an increase of 1,512 cwt. over 1929. It is hoped that the work of the Fibres Committee of the Imperial Institute will lead to an increased demand for Empire sisal and that the industry will also benefit from the programme of sisal research to be carried out at Amani.

Native food and other crops.—Certain areas suffered from drought, particularly Chikwawa where maize had to be imported from Cholo, and seed was given free, but on the whole native maize, millets and other food crops gave good yields. An interesting experiment in the communal storage of grain has been instituted by the District Agricultural Officer, Port Herald, and the District Commissioner, and its results will be awaited with interest. Large quantities of groundnuts were grown by the natives of the Liwonde district and were sold locally. A certain number of trials of native food crops for yields and suitability to local conditions have been carried out, but there is need for a more intensive investigation than has hitherto been possible and for selection and breeding work which will improve local varieties. Trials of new native cash crops are also being considered, and the development of wheat growing may be taken up. Along with a study of native crops there is required an investigation of native agricultural methods, particularly from the point of view of soil degeneration and soil erosion as affected by shifting systems of cultivation and by bush burning and deforestation, and attention to the management and improvement of *dambo* soils is also required.

The lake shore rice industry calls for investigation of its seed stocks and its methods of cultivation. Mass selection work has been planned and trials of varieties will be made under different conditions of cultivation. The opinion is held that an immediate large increase of rice production would be bad policy on account of the difficulty of finding markets and of marketing cheaply, and the Department of Agriculture intends therefore to proceed in the first place with the work of crop improvement. It is estimated that in the Karonga area 171,936 lb. was produced, of which 55,440 lb. was exported from the district. The remainder was consumed locally.

PART II. WORK OF THE DEPARTMENT OF AGRICULTURE.

District work.—Details of the district work of the Department of Agriculture will be found in annexures A and B. The Department possesses no properly-equipped district Experimental Stations and its field or district staff is in need of augmentation. The District Agricultural Officer, Port Herald, co-operates in the work of the Empire Cotton Growing Corporation Experimental Station near Port Herald, and the District Agricultural Officer, Karonga, has acquired for experimental purposes the loan of a small area near Karonga through the courtesy of the African Lakes Corporation.

Good work has been done in the Port Herald area in the form of talks and demonstrations to native cultivators on such matters as preliminary cultivation, planting and thinning of cotton, seed selection and ploughing. Local agricultural practice is under study and the work of the Native Agricultural Instructors has been reorganised and put upon a proper basis. The trials of sheep and of the communal storage of grain may have important and far reaching results and are therefore of great interest. Details of the work carried out on the Empire Cotton Growing Corporation Station will be found in annexure F, but it may be noted that the work of the station is being extended to include food crops as well as cotton.

In the Karonga district, the District Agricultural Officer carried out a survey of the Misuku Hills from the point of view of their suitability for a native coffee industry, and he established Experimental Plots for trials of varieties of cotton, food crops and oil seeds. Special attention is now being given to rice cultivation. The district was re-opened for cotton cultivation after a close period of five years due to the presence of pink bollworm, and 61 tons of seed cotton were produced. This amount largely exceeded the estimated crop. The variety planted was the Empire Cotton Growing Corporation's *Over-the-top*. The native growers were interested in the revival of cotton growing and in the high yield obtained, and it is regrettable that market conditions do not permit of the immediate encouragement of cotton growing in North Nyasa.

Chemistry and Soils.—Much of the work of the Agricultural Chemist of the Department of Agriculture has been devoted in recent years to the problem of the maintenance of soil fertility. The aim of the work is to provide a basis for the maintenance of a certain standard of fertility in a given soil which is expected to grow a certain crop.

In the case of tobacco, efforts are being made to devise manurial formulae for soil types growing definite types of leaf. It is known, for instance, that local red loams are deficient in lime and phosphates and measures can be taken accordingly. Rotation schemes and manurial programmes with green and cattle manuring for maintenance of organic matter can be recommended. It does not pay to use fertilizers for cotton, but the crop can be manured indirectly through the manuring of other crops in the rotation. In the case of tea and coffee, most attention should be given to the maintenance of organic matter by cattle and green manuring.

The work in hand has involved the undertaking of a soil survey, a large amount of laboratory investigation, and practical work in the field. The aim of a soil survey is the classification of soils by their properties, a knowledge of which points to the most suitable treatment for each type of soil, and the soil survey of Nyasaland has shown that the main groups of African soils occur in the country. These are laterite, lateritic red loams, ferruginous red loams (which occupy the largest area), red loam, grey-brown soils and pedocalic (i.e. lime-accumulating) soils. The soil types are classified according to the constitution of their clay as it is shown by the ratio of silica to alumina and iron oxide found in the laboratory. Special attention has been given to laboratory work on the carbon-nitrogen ratio of cultivated soils whereby valuable information on the condition of the organic matter is acquired. The maintenance of organic matter has a large influence on the absorptive properties of soils and, therefore, on their liability to erosion, and it is thus of extreme importance. The recognition of its importance and of the necessity for controlling erosion has led to the introduction and trials of useful cover and green manure plants and to propaganda in favour of ridge terracing and other methods of conserving soil. The *O-too-tan* soya bean which gives a low bushy succulent growth which rots easily, the *Biloxi* soya bean which is a good second to *O-too-tan*, sunn hemp (*Crotalaria juncea*) and *Indigofera endecaphylla* have proved most successful, and pigeon pea (*Cajanus indicus*) is considered one of the best rotation crops for tobacco, especially in ferruginous red loams. *Crotalaria anagyroides* and *C. usaramoensis* have given disappointing yields of green stuff and clovers have not done well. A collection of indigenous low-growing species of *Indigofera* is being made with a view to their trial as permanent ground covers. It is the writer's opinion that experiment with permanent ground cover plants in permanent crops like tea and coffee is required in Nyasaland, and it is hoped to undertake it at an early date on a proposed Tea Experimental Station and coffee plots.

Ridge terracing work was begun in 1923 but the progress made has been on the whole slow and disappointing. One is forced to the conclusion that planters have not fully realised its benefits or the losses of soil and plant food that are incurred on unprotected slopes. As large areas of the Protectorate show a comparatively shallow surface soil, there is all the greater need for attention to soil conservation.

Entomology.—Tobacco aphis was severe in 1930 and attention may therefore be directed to the recommendations made in the Entomologist's report (annexure D.) and especially to the relevant remarks in the conclusion of the report. Capt. Smee's notes on tobacco mosaic, tobacco eelworm, coffee pests and general policy are worthy of study, and special attention should be given to his remarks on the place of spraying in local agriculture.

The report of the Cotton Specialist of the Empire Cotton Growing Corporation (annexure F.) contains interesting notes on the occurrence of cotton pests and it also points to the possibility of evading the attack of a pest (stainer) by modifying planting practice. Conditions in the Port Herald district seem to be remarkably antagonistic to the development of cotton pests during the season when the crop is in process of being made, a matter for congratulation.

Mycology.—The Mycologist of the Department of Agriculture is stationed in the tea district of Mlanje. His laboratory accommodation and facilities are only of a temporary nature and are poor. His work has been confined to the diseases of woody permanent plants like tea and special attention has been given to the experimental work on the disease known as tea yellows. The results of the experimental work are promising but they are not sufficiently advanced to enable definite pronouncements to be made. The yellows disease has been regarded as a deficiency disease or a disease of weakness, but it has recently been shown that there is a root fungus (*Rhizoctonia bataticola*) in association with every case of tea killed by yellows. The disease may therefore be regarded as a root disease, but it does not follow that yellows is no longer to be regarded as a disease of weakness or of soil deficiency. The experimental work in hand should give results which will be applicable whether yellows is a root disease or not, and, if so, it will follow that the root disease is itself a disease of weakness. Attention may be directed to the useful work done on stem and branch canker of tea and to the occurrence of violet root disease of tea seedlings.

Botanic Gardens, Zomba.—The trees and plants in the Botanic Gardens require to be labelled but it is difficult to get the work done. The slopes had suffered severely from denudation in the past and their appearance was spoiled by the growth of rough grass. An effort is therefore being made by draining, contour terracing and green manuring to bring the slopes back into good condition through reconstitution of the areas of washed-out soil.

Publications.—The following have been published during 1930:—

Agricultural Series:

Bulletin No. 1—Report on the Possibilities of Tree Nut Culture in Nyasaland, by I. Tribolet, Late Chief Horticulturist, Department of Agriculture, Union of South Africa.

Circular No. 5—The Cultivated Sorghums of South Nyasa, by F. Barker, C.D.A. (Edin).

Agronomic Series:

Bulletin No. 3—Studies on Three Important Soil Series of Nyasaland, by A. J. W. Hornby, M.B.E., B.Sc., A.I.C.

Bulletin No. 4—A Short Comparison of Tea Soils and Climates in Various Parts of the World, with some Deductions concerning Treatment of Soils, by A. J. W. Hornby, M.B.E., B.Sc., A.I.C.

Entomological Series:

The Development of Insects as Pests of Tea, by C. Smee, M.C., D.I.C., F.E.S.

Eelworm in Tobacco Seedbeds, by C. Smee, M.C., D.I.C., F.E.S.

Visitors.—During 1930 the Protectorate was visited by Mr. F. A. Stockdale, C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, Mr. P. H. Haviland, Irrigation Engineer, Department of Agriculture, Southern Rhodesia, and Mr. Norton Breton. Mr. Stockdale entered the country from Northern Rhodesia and proceeded to Zomba via Lilongwe, Dedza and Ncheu. He also visited the tea district and addressed the tea planters in Mlanje and the Convention of Associations in Blantyre. The opportunity was taken to discuss with Mr. Stockdale a projected extension of the work and staff of the Department of Agriculture. Mr. Haviland's visit was instructive and did much to arouse interest in soil conservation in general and ridge terracing in particular. Mr. Breton reported favourably on the possibilities of silkworm culture but conditions are not at present sufficiently encouraging to enable the matter to be taken up.

Staff.—The following officers of the Department were on leave during the year:—

Mr. E. W. Davy, M.B.E., Assistant Director, from August 2 to December 31.

Capt. A. J. W. Hornby, M.B.E., B.Sc., A.I.C., Agricultural Chemist, from January 1 to February 19.

Mr. F. Barker, District Agricultural Officer, from January 1 to June 6.

Mr. J. A. Callow, Senior Clerk, from June 21 to December 31.

Mr. E. W. Davy acted as Director of Agriculture from January 1 until his departure on leave, and Capt. C. Smee, M.C. from July 31 until October 11. The writer arrived at Beira on October 10th and assumed duty as Director of Agriculture on October 12th. Capt. A. J. W. Hornby, M.B.E., acted as Assistant Director from October 12 until the end of the year, and Mr. J. A. A. Channer acted as Senior Clerk during the absence of Mr. J. A. Callow.

PART III. WORK OF THE EMPIRE COTTON GROWING CORPORATION.

Much of the credit for the size and excellence of the 1930 crop of cotton was due to the experimental work and planting date propaganda of the Cotton Specialist of the Empire Cotton Growing Corporation and also to the success of *Over-the-top* seed in up-country areas. It has already been noted that *U4* cotton promises so well that plans are in hand to put it into general distribution in 1933.

The experimental work of the Corporation was continued on the Makwapala and Port Herald Stations and good progress was made with the development of the new Domira Bay Station on which cotton breeding work will be centralised and on which variety, time of planting and spacing trials will be carried out along with observations on the behaviour of various strains. Rotations with food crops will also form part of the work.

At Makwapala special attention has been given to the improvement of laterised soil through the use of implements to obtain deeper ploughing and better tilth, farm-yard manuring and the growing of deep-rooting legumes which penetrate the pan. A soil survey showed that the depth of soil above the pan was such as to cause cotton to behave as a shallow-rooted crop and to become liable to suffer from drought and therefore pointed to the practical and useful nature of the work referred to. Useful rotational work has been done, and soil erosion has been satisfactorily controlled by ridge terraces. Special attention has been given to the relationships of cotton and tobacco, both of which are important as native cash crops. Spacing experiments with *U4* showed that there was a "progressive increase of yield with increase of plant density" and that the denser spacings gave an earlier and heavier first picking. These results are of practical value.

At the Port Herald Station the cotton area was increased to 30 acres. Work was concentrated on *U4* and a *Cambodia* strain, and trials were continued and combined with time of planting and spacing experiments. The latter gave results which indicated that yield was greatly influenced by plant density and the experiments will be repeated. Earlier work has pronounced in favour of early planting after the first main rains. Cotton breeding work was continued and a number of strains has been provided for jassid and drought tests under Domira Bay conditions.

PART IV. NATIVE TOBACCO BOARD.

Under the head of *Tobacco* an account of the activities of the staff of the Board has been given. The staff was increased during 1930 by the appointment of Messrs. F. F. Smithyman, R. E. Jackson, A. G. H. du Frayer, A. B. Cormack, J. Foot and F. I. Scott as Supervisors.

The following officers of the Board were on leave:

Mr. R. M. Antill from January 1 until January 30.

Mr. J. W. Burton from July 5 until December 18.

Mr. R. J. Sanderson from July 18 until December 31.

The resignation of his membership of the Board by Mr. A. F. Barron in the month of June created a vacancy which had not been filled at the end of the year. At that time the members of the Board were:

The Director of Agriculture (Chairman).

The Honourable The Treasurer (Mr. K. R. Tucker).

The Honourable The Acting Senior Provincial Commissioner (Mr. A. J. Brackenbury).

W. Tait-Bowie, Esq., O. B. E.

with Mr. J. A. A. Channer as Acting Secretary.

The writer wishes to record his thanks to all the members of the staff of the Department of Agriculture for their work and particularly for their helpfulness to himself as a newcomer to Nyasaland, to the Cotton Specialist and other members of the staff of the Empire Cotton Growing Corporation for their co-operation and unfailing courtesy, to the staff of the Native Tobacco Board for their work, and to the staff of the British Cotton Growing Association for their efforts on behalf of the cotton industry of the Protectorate.

W. SMALL,
Director of Agriculture.

Report of the District Agricultural Officer, Karonga, for 1930.

I returned from leave early in June, 1930, and on arrival in the Protectorate was posted to Karonga for duty in the North Nyasa district.

General.—As there was no housing available for a District Agricultural Officer at this new district agricultural headquarters accommodation had to be built. Money was voted for this work and immediately upon my arrival at Karonga I commenced to make the necessary bricks. Supervision of building operations could not be provided by the Public Works Department and therefore this devolved upon myself. A double-storeyed residence (with office), eminently suited to the climatic conditions of the lake shore, is now all but completed and my thanks are due to Mr. O'Brien, District Commissioner, for his able and ever ready assistance throughout the period of construction. To Mr. Holt, Stock Inspector, I am also indebted for much timely advice in this connection.

Travelling.—Thirty six days were spent on *ulendo* in the district during which time a close study of the areas traversed was made.

Cotton.—The embargo imposed upon cotton-growing within the district in 1925 on account of the presence of pink bollworm (*Platyedra gossypiella* Saunders) was removed in January of this year and the industry recommenced under rules brought into force with a view to prevent the spread of the pest too ther areas should it again make its appearance. Only lint baled for export is permitted to leave the district and to arrange for this Messrs. Baxter and Maxell fitted their Ngara Ginnery with a baling press capable of turning out 448 lb. bales of 85c. ft. measurement. Suitable arrangements were also made at the ginnery for the heat treatment of seed should the necessity for such measures arise. Permission to grow arrived too late to influence natives in the early planting areas who had not prepared gardens in anticipation of the removal of the embargo and therefore the bulk of seed available went to the late-planting Ngerenge-Lufira-Tsongwe area where cotton normally follows rice and is planted during the months of May and June. The seed issued was *Over-the-Top*, a strain brought out by the Empire Cotton Growing Corporation.

Total seed issues were as follows:—

Area	Recipients	Seed issued	Total crop
Early planting ...	71 ...	1,246 lb.	136,990 lb.
Late planting ...	277 ...	5,288 lb.	

The crop was an exceedingly good one and fully bore out the high-yielding qualities of *Over-the-Top*. It is interesting to note that despite the enforced period of rest from cotton growing in North Nyasa there was evident a high incidence of the red bollworm (*Diparopsis castanea* Hmps.) and to a lesser degree of the spiny bollworm (*Earias biplagar* Wlk.) The crop was purchased jointly by Messrs. The African Lakes Corporation and Mr. Maxwell of Nyungwe Estates who paid an all-round price of 1d. per lb. for seed cotton. Native growers were very satisfied with the money they received for their produce and acknowledged the enhanced yields which they had harvested through the introduction of the new seed. A wave of enthusiasm towards greater efforts in native cotton cultivation prevailed as a result which makes it all the more regrettable that the cotton market is meantime in so depressed a state. Had it been possible to guarantee the paying of this season's price in 1931 the industry would have made rapid strides forward. Present indications are that the industry will drop out until the prospect of an improved market presents itself. When native cotton is again active it is recommended that two district cotton-buying centres be established, one at Karonga to meet the requirements of the potential Karonga enclave represented by the area lying between the rivers N. Rukuru and Ruwasyo and extending inland to a point near to Mpata and the other at Kapora to serve the late-planting area.

Rice.—This crop is extensively cultivated in one well-defined area to the N.N.W. of Karonga which can be referred to as the Ngerenge-Lufira-Tsongwe area. This country which could scarcely be more ideal for rice culture is approximately 50 sq. miles in extent and its population includes about 3,000 adult males. The crop is grown almost entirely as a cash crop. The season's crop for 1930 was lighter than is usual on account of adverse climatic conditions and is estimated to have totalled 171,936 lb. of cleaned rice. Of this total 55,440 lb. was exported out of the district. Rice sales receipts to the natives concerned would approximate to £400 for this crop. The purchase price paid is from 3/- per bag of 60 lb. for red or mixed rice to 4/- per bag for a good grade white rice. Two tons of white rice were purchased by a down-country Indian merchant at the high figure of 10/- per bag. The white rices *msafili*, *faya* and *malya* are in demand by Indians and are certainly value for 4/- per bag if red rice and mixed and broken rice can command 3/- per bag. The latter is considered too high a price if the securing of a really big internal market is to be aimed at. Unfortunately the North Nyasa native as a whole holds somewhat exaggerated views as to the value of his produce and in particular with regard to rice. He considers that present prices are too low and constantly asks for the price to be increased. Every endeavour is being made to make him see the force of increased production per acre by employing better methods and to show him that if such are practised his increased yield will more than compensate him for what he considers to be a low purchase figure. It is desirable that the price be not increased and that if possible it should be slightly reduced. Commensurate with this move efforts

will be put forward to both increase the acre yield and the quality of the crop and at the same time educate the native farmer up to a better understanding of crop values and markets. With a view to stimulating greater interest in the growing of pure seedings it has been intimated to growers that Government is willing to pay 4/- per bag for a high grade white rice and but 3/- per bag for the lower grade when purchasing its requirements from North Nyasa for 1931 and it is hoped that this may prove an incentive. The success of this industry must depend on an initial selling rate such as will allow the commodity to bear transport costs and other charges and yet retail at a price competitive with the same article produced elsewhere and seeking the same market. There are, to my knowledge, nine varieties of rice grown within the district and it is unusual to find a pure seeding of one in any one garden. A mixed product results and such as will not attract a really good market. The Wankhonde native's method of cultivating the crop could also be improved. The usual method of planting practised by him is to broadcast the seed immediately before the rains are expected. In consequence stands are unduly thin, weeding more difficult and acre yields lighter than they need be. The native does know of the nursery and transplanting method but frankly admits that it is much more irksome and therefore prefers the easier way. It is hoped, however, that in time teaching and demonstration may win growers over to an all-round better conception of the advice and instruction offered.

Coffee.—A close study of the Misuku Hill areas of this district with a view to investigating the possibility of native coffee culture and available coffee-growing areas there was carried out in the months of August and September. The successful native cultivation of coffee requires a comparatively large and compact area to be devoted to it, ideal conditions of soil and climate, and a quick and ready means of transport to an assured market. A combination of these conditions not occurring in the Misuku, the possibility of establishing a successful native coffee industry there was out of the question. At this juncture it might not be out of place to briefly describe the Misuku and its approach from Karonga. The Misuku is situated two full days' march to the N.N.W. of Karonga and is at an altitude varying from 4,000 to 7,000 feet approximately.

After traversing some twelve miles across the Ngerenge rice flats the foot-hills which rise abruptly are reached. Thence through much extremely hilly and broken country for some thirty miles to Kasumbi Hill (5,100 ft.) which brings one to the southern border of the Misuku proper. This intermediate foothills area is at an elevation of 3,500 to 4,000 ft. and is of the open forest type of country in which the dominants represented are *Bauhinia, Protea, Uapaca* and *Brachystegia.* Approaching the Misuku from the northern side on the Kaseye at 4,000 ft. similar country of open forest lands is encountered but here *Acacia* and isolated palm stands also occur. The Misuku country itself is best described as mountain grassland type bearing plants of a shrubby nature, braken, grass and sparse and stunted tree life. In the sequestered areas provided by the many stream beds which abound the villages are generally situated, and in these a few trees of more or less normal growth remain. These more sheltered areas are known as *chiwandas* or *chikururus.* The former may be planted in the rains and still retain sufficient soil moisture for secondary cropping to follow whilst the latter flood in the wet season and may only be planted in the end of the rains or used as grazings. The crests of the highest hills at some 6,000 feet above sea level are capped by a sharply defined type of closed fringing or mountain forest which carries down for a short distance only save where it extends down a portion of the precipitous gulleys which cut into the hillsides. Otherwise never do these so-called rain forests reach the lower hill slopes. Some of the larger trees in these hill-cap *misitu* have somewhat poorly developed buttressed roots and this, together with a profusion of tree ferns, has no doubt prompted the use of the term when reference is made to them in some quarters.

It is obvious to the most casual of observers that much tree life in the Misuku and its vicinity has disappeared through human agency. Wherever a semblance of tree life remains there is evidence of pollarding and pruning to obtain wood for the fire, charcoal for the blacksmith and woodash for the soil of the finger-millet garden. The finger-millet is extensively cultivated in this part of the district and I have seen a garden carrying as much as 1,000 yards to the acre of brush-wood up to 2 inches in diameter in readiness for burning. Little imagination is required to visualize the destruction of forest land which is taking place especially when added to this is the fact that new *malesi* gardens are continually being opened to replace those which are worn out. Even more so is this the case where timber is not so plentiful as to allow of an adequate ash supply wherewith to enrich the soil with potash.

In the Misuku a method of threshing finger-millet (*Eleusine coracana*) was encountered which hitherto had not been observed elsewhere in Nyasaland. The ripened heads of grain are totally immersed in a pool of water provided for the purpose. This process of retting takes about a month to complete. The heads are then washed and the grain comes away freely. These again are washed, then spread out, and thoroughly sun-dried for storage. Natives inform me that germination of seed is in no way impaired by this procedure.

Experimental Work.—By courtesy of Messrs. The African Lakes Corporation I was enabled to open a small experimental area on land generously allowed me for this purpose. Briefly the work in hand is as under:—

a. Cotton.—Three strains *U/4, Cambodia G.C. 664,* and *Over-the-top* are being planted at monthly intervals during December, January and February in search of information as to optimum planting dates and observations as to their behaviour and the effects of insect attack on individual plantings of each strain. It is hoped that a similar series can be repeated in the late planting area also.

b. Food crops. Comparative tests and trials of the following:—

Maize— Potchefstroom Pearl.
Karonga Local.

Ground-nuts— Spanish Bunch
Gambia Basse variety
E.C.G.C. selection—*chimbwila*
Karonga Local
Fort Johnston selection—*ntedza wenandi.*

Finger-millets—Fort Johnston selection—*kangumba* (early variety).
Malesi
Karonga Local.

Miscellaneous—*Sesamum indicum*, cassava varieties, green gram (*Phaseolus radiatus*), etc. for observations and demonstration.

It is hoped that much useful information on local planting conditions may be obtained as a result of the work on this area.

Staff.—No trained native staff was available for work in this district and I have therefore had to make the best use that I could of local untrained material. A centre for training of suitable native field staff would meet a long-felt want in this connection.

Labour.—Field labour costs 4s. to 5s. per month but the output of work per capitao is much under that of the more expensive down-country labour.

F. BARKER,
District Agricultural Officer.

Annexure B.

Report of the District Agricultural Officer, Lower Shire and Chikwawa Districts, for 1930.

The Lower Shire and Chikwawa districts were without a District Agricultural Officer during the latter half of 1928 and practically the whole of 1929. Cotton work, uprooting and seed distribution, was carried out during this period and for 1930 by Mr. Stephens in Chikwawa and Mr. Boby in Chiromo. The fact that the area under cotton has increased steadily is in great part due to their work.

The lectures of Mr. Clegg, late District Agricultural Officer, to the natives are still remembered by them, and the lessons he taught have not been forgotten. The writer has carried on with these lectures, which undoubtedly gained the interest of the native grower. The work of improvement is of necessity very slow but it does go on, and if the majority of the natives forget as quickly as they learn the few that do not forget, by their example, help the work forward another step.

Meteorological.—The total rainfall for the year 1930 was 24.47 inches. The total seasonal rainfall (November, 1929 to October, 1930) was 26.00 inches. The hottest month of the year was November with an average maximum temperature for the month of 100.6°F. and an average minimum of 75.4°F. The coolest month was June with an average maximum for the month of 79.9°F. and an average minimum of 55.0°F.

From January 21st until the end of February there was a rather serious drought; some light showers fell in February but evaporation was heavy and the rainfall was totally ineffective. Cotton planted before March suffered badly; many gardens had to be replanted and others failed to bear a crop. Millets too suffered badly. *Machewere* (*Pennisetum typhoideum*) was an almost total failure and *mapira* (*Sorghum vulgare*) never recovered from the setback, yielding poorly. Maize did not suffer so badly. The first crop was already ripening by February and the second crop, planted with the March rain, did well.

It may be noted here that these remarks on the crops are only general for the whole 2,600 miles of the Chikwawa and Lower Shire districts. Rainfall is often very local and in the case of cotton, for example, some gardens between Chiromo and Port Herald were planted in January, after a heavy local fall, and yielded extraordinarily well.

Cotton.—The crop this year was good throughout the whole of the Lower River, and a record yield was obtained. The seed stores were opened early in January, but serious planting did not commence until March. By the end of the month most of the planting was finished. The abnormally light rainfall during the dry season was responsible for the absence of the second flush of flowers that is usually expected in August or September. Flowering, however, continued throughout the season and the yield was above average. The number of cotton gardens increased considerably this year.

During the early part of the year most of the villages in the Port Herald district were visited personally and short talks given to the native growers on deep preliminary cultivation, proper planting and thinning.

From the past five years' experimental work on the E. C. G. C. Station at Port Herald it is apparent that the last word has not yet been said on thinning. There is probably a happy medium between the European method of thinning down to two plants to a hole and the native method of leaving from ten to twenty. There will certainly always be a fairly wide margin as to the number of plants per hole, and the native idea of plant density per acre is probably the correct one. It is thought that improved yield will come from putting the plants closer but leaving fewer to a hole, so that the actual plant density remains unchanged. The present native method is to a large extent governed by his laziness but the first step has been made of inducing him to plant in lines and as further knowledge is gained it is believed that he will listen more readily to further teaching.

With regard to time of planting of the cotton crop, this varies, of course, with the coming of the rains. The crop here is a dry-season crop and planting is with the second rains, contrary to the up-country planting with the first rains. Careful records have been kept for the past four years at the Port Herald Station and from these it may be seen that a fairly safe sowing time, apart from any question of insect control, is with the first good rain after February 15th. This is a very loose rule with many exceptions and subject to many modifications. Further support for this date is obtained when the question of insect control is considered. The attack of red or Sudan bollworm (*Diparopsis castanea*) reaches its height about the third week in June and then dies away rapidly. The real crop therefore comes from the flowers that open after June and cotton planted after the middle of February, on land similar to that of Port Herald Station, gives its heaviest flush in July, when the attack is dying away. On the lighter sandier soils, which dry out very quickly in the dry season, the natives prefer to plant early in January and it is believed that they are wise to do so.

In the native gardens the average yield per acre of seed cotton (of all grades) was 250 lbs. on the lighter *mpala* land and 350 lbs. on the heavier *dimba* land. The lowest and highest yields on *dimba* land were 165 lbs. and 880 lbs. per acre respectively; on *mpala* land 78 lbs. and 884 lbs. The figures do not pretend to be very accurate; they were obtained from measurements of some seventy gardens chosen haphazard throughout the district, the yields being obtained from the receipt slips, for cotton sold, in the growers' possession.

The following figures are of interest in regard to the 1930 cotton crop. They include the Chikwawa and Lower Shire districts.

Cotton seed issued lbs.	No. of issues	Average issue lbs.	No. of cotton gardens	Total pop.	Seed cotton sold lbs.	Cost
1,371,474	37,610	36.4	27,495	56,878	10,601,584	£42,211 8s. 11d.

Total population is obtained from the number of tax-payers and exemptions for 1929.

The seed cotton sold may be divided up as follows:—

No. 1 grade	9,383,028	lb.	@ 1d. per lb.
No. 2 „	1,177,685	„	„ ⅝d. „ „
No. 3 „	40,871	„	„ ½d. „ „
	10,601,584		

From the above figures it will be seen that there was roughly a cotton garden for every two tax-payers; that for every lb. of seed issued 7.8 lb. of seed cotton was produced; that the proportions of Nos. 1, 2, and 3 grades were as 100, 13 and .4.

Cotton pests.—Cotton stainers (*Dysdercus cingulatus* and *D. nigrofasciatus*) did not appear in numbers until late in the season but caused an appreciable amount of damage, as evidenced by the amount of No. 2 and 3 grades bought at the markets; a great deal of the stained cotton was due to the stainer-carried boll-rots, red bollworm attack, owing to the late planting from lack of rain being very much less serious than usual.

Uprooting.—By the Cotton (Uprooting) Rules, 1926, the date fixed for uprooting and burning the crop was December 15th. This year, in the Lower Shire district, there were 104 defaulters and in the Chikwawa district 99.

Cotton seed.—During the year samples of cotton seed were obtained from the seed stores in the Chiromo and Port Herald areas and germination tests were carried out. These revealed the fact that owing to bad storage a great deal of the seed was being spoilt and was quite unfit for planting. A suggestion was made to the British Cotton Growing Association that this waste could be checked by the erection of a more permanent and weatherproof type of store. A further suggestion was made regarding the books used at the stores and an improved pattern is in use this year.

Experimental cotton plots.—In addition to the time of planting and spacing trials on the Empire Cotton Growing Corporation Station, three small observation plots were established on the heavier *dimba* land on the Ndindi marsh. These were planted early in April on sites that are in normal years flooded. The soil on all three was stiff black alluvium, very difficult to work, very sticky when wet, and drying out in the dry season with a hard crust which later cracks. The plots were all roughly square and 1/20th acre in area. Each plot contained three different varieties, *Cambodia*, *Nyasaland Upland* and *U4*. One of the plots was purposely planted on the same day that the grass was hoed off, unfortunately a rather common native practice. The other two were well dug over before planting. The first was a complete failure; the other two yielded very well. As many natives as possible were brought along to see the three plots and the lesson that good cultivation pays was drilled in as hard as possible. There was little to choose between *U4* and *Cambodia* but both, under the marsh conditions, appeared to be superior to *Nyasaland Upland*.

Three small observation plots were planted early in March on Malawe Plateau, at an elevation of 2,500 ft. The General South African Mission at Chididi kindly saw to the weeding and thinning of these plots. They were unfortunately a complete failure; from general observation it appeared that to be successful cotton should be planted here with the first rains in November. Apart from this the soil of these hillside gardens has been eroded so badly in past years that it is doubtful whether cotton would be a suitable crop at all. The Mission is anxious to find a cash crop that will induce the natives to remain in their villages instead of migrating to the plains, and next year an attempt is being made to teach the natives to terrace their gardens and to grow maize and pineapples, both of which do very well there.

Native food crops.—The *machewere* (*Pennisetum typhoideum*) crop this year was very poor. The very scanty rainfall in January and its absence in February resulted in poor wizened plants with small poorly developed heads. The native characteristically sat down and watched the birds eat most of what the poor season left him. Little birds-scareing was done and it is estimated that the average yield per acre this year was in the neighbourhood of 300 lb. (1,000 to 1,200 lb. is a fair yield per acre for this crop). Very little smut was seen this year.

The *mapira* (*Sorghum vulgare*) crop was saved by the March rains but a bad attack of stem borer (*Chilo* sp.) caused great damage to the heads just before they opened. Generally speaking the crop yielded fairly well. It was found that ratooned *mapira* was particularly badly attacked by the borer and that unburnt and partially burnt stalks contained live pupae as late in the year as

September. In talks to the natives the system of ratooning *mapira* was discouraged and they were advised to burn all *mapira* and *machewere* stalks directly after harvest. The average yield per acre of *mapira* was estimated at 400-500 lb.

In the majority of gardens the first crop of maize, planted with the November rains, yielded well. It was in cob by the time the February drought came and suffered little. Maize planted in December, however, was caught and developed small cobs and a poor crop.

The fact that most of the *dimba* land did not flood this year resulted in a quick drying out of the soil and by September large cracks were appearing all over the marsh. In consequence the second maize crop was short in straw and small in cob giving only a moderate yield. The average yield per acre of the first crop was estimated at 1,200 lb. that of the second at 450 lb. Maize was badly attacked by the same borer that attacked the *mapira*, and natives were advised to burn the stalks directly after harvest.

The rice crop was almost a complete failure. Drought finished off all but the earliest planted and even this yielded very poorly.

Sweet potatoes gave a fairly good first crop but the succeeding crops were poor. The comparative failure of this crop, that normally tides the natives over the famine period of December and January, was particularly serious this year in view of the scarcity of grain.

Beans also yielded poorly. *Nseula* and *mulasa* (varieties of *Vigna catjang*) yielded fairly well in some gardens but on the whole the crop was poor.

It is an unfortunate native trait that when a bad season comes hope is given up quickly and birds and weeds are allowed to finish the work that an adverse season has started. The native is unfortunate in that he is every year going through a period of food shortage and hunger just when he needs all his strength to dig, plant and weed his garden. If he can be persuaded to realise that the months of December, January and February are all-important to him and he can be helped to conserve his foodstuffs so that he is not on the verge of starvation during this time a great move forward will have been made. A scheme is on foot to help him to conserve his foodstuffs and it is believed that realisation of the importance of proper planting and cultivation is slowly coming.

Native Agricultural Instructors.—The nine Native Agricultural Instructors (three at Chikwawa, three at Chiromo and three at Port Herald) were called in this year, in July, for a short course of general agricultural instruction. Visits were made to the Empire Cotton Growing Corporation Station and the work there explained in detail. At the end of the course each Native Agricultural Instructor was given a Farm Diary which has to be written up daily. In this is entered the date, names of villages visited during the day, the crops seen and the operations in progress. Notes on insect pests, bird damage, etc., are encouraged and one or two of the Instructors are already showing quite acute powers of observation. Two diaries are allotted to each native and are periodically changed so that the District Agricultural Officer is able to check the accounts of visits made and see that the notes made are the results of observation and not of ingenuity.

Their work this year has consisted of travelling from village to village helping and instructing the villagers along the lines laid down in lectures to them. When the District Agricultural Officer goes on *ulendo* they accompany him and they have been encouraged to deliver lectures themselves to the natives. They are also encouraged to go into the gardens when the natives are at work and show by demonstration what is meant by planting in lines, thinning, selecting seed, mulching, etc. It is hoped that later each Instructor will be put in charge of a small 2-acre demonstration plot, these plots to be scattered through the districts. This year they were responsible for a census of native cotton gardens and for the observance of the Cotton Uprooting Rules in December. They also assisted in the issuing of cotton seed but next year this work will be carried out entirely by the native staff of the British Cotton Growing Association while the Instructors will be out in their districts helping with the planting and intercultivation of the food-crops and cotton.

Native agriculture in general.—During the year the whole district has been toured and lectures given at many of the larger villages. Audiences varied in numbers from 50 to 250 and evident interest was taken. The importance of deep and thorough primary cultivation, proper planting in lines, clean intercultivation and seed selection was stressed. Where possible visits were made to the village gardens first and after the lectures short talks were given on the insects seen, specimens of which were handed round. Advice was given as to their control.

It is believed that the native has yet some way to go before he will be willing to adopt any scheme of crop rotation. Under the present system of native agriculture, with no sort of land tenure, with a continuity of holding existing for five years at the most, interplanting has a much stronger appeal to the cautious native mind. To have his garden or part of his garden carrying only one crop appears to him to be a very risky proceeding. Insects and seed-eating birds all take their toll of his crops and he likes to see as much planted as his land can possibly hold. It is felt that the first step is to improve the native seed stocks and the methods of interplanting. With better methods, better seed and better yields will come confidence. And once the native has confidence in himself and his garden, and not before, he will adopt crop rotation.

The native is being encouraged to carry out his own seed selection. The principles have been explained in lectures and, judging by the questions asked, interest has been awakened. The Instructors are fostering this interest and next year an offer is being made to store selected seed for natives at the Empire Cotton Growing Corporation Station, to be returned to them at planting time.

A little selected seed was issued to applicants for November sowing, on condition that they planted on properly cultivated land, in lines, and looked after their crop. The gardens have been inspected and the natives and their wives shown how to plant in lines. This will be repeated next year when there will be more spare seed available but it is felt that it is better for the native to learn to do his own field selection and not to depend upon necessarily small issues of seed from the District Agricultural Officer.

One or two of the more progressive natives have asked that their gardens may be ploughed. Their gardens have been inspected and at least one will be ploughed early in 1931 and more if the bullocks can be spared from the work on the Empire Cotton Growing Corporation Station. This will be done on condition that the natives in question agree to subsequently plant and cultivate properly.

Next year the more progressive natives will be helped and encouraged in improving their gardens. Unfortunately most of the more intelligent and advanced natives are not primarily agriculturalists. They are clerks or capitaos and their gardens are cultivated by their wives and by hired labour. They are willing to use improved seed and methods but lack the time and opportunity to work on the land themselves or to even carry out efficient supervision. Some of the mission teachers have come in and expressed a wish to be helped with seed and instruction. This will be given and these scattered gardens will serve as demonstration plots to the natives round as to what can be done by the native himself.

Empire Cotton Growing Corporation Station.—The whole of the 30 acres was planted up with cotton, including spacing and time of planting trials. A further 20 acres were cleared, stumped, ploughed and marked out into eight 2½-acre fields ready for planting next year. A site for a 10-acre *dimba* plot was found in the Ndindi marsh about 3½ miles south of Port Herald.

Fourteen small observation plots were planted with various native food-stuffs, mainly with the object of providing seed for next year's planting. Some selection work was done on *mapiras*. A small yellowish-red-grained variety of maize from British Honduras (introduced by Mr. Sampson) showed great promise both on one of these plots and as a late-planted crop on *dimba* land.

Next year 25 acres of the Station are being planted with native food-stuffs and the possibilities of various methods of intercropping are being tried. Cotton is being included in these observation tests.

Native crops.—With the object of gaining as much information as possible on the various native crops grown in the district a collection of the seed of every kind has been made and will be planted out for observation purposes next year. The collection includes, as far is known, all the native varieties of millets, sweet potatoes, pulses and *Cucurbitaceae*; notes will be kept on habits of growth, yields, etc.

Native livestock.—A small flock of native sheep has been purchased for the Station and it is proposed to fold them off next year on sweet potatoes and other native crops. Hurdles are being made on the Station. It is believed that the native sheep should play a more important part in native agriculture than they do and that, if it was run on proper lines, the native would find his small flock a profitable investment. Later it is hoped to carry out some work on goats, pigs and poultry.

Trees.—A small nursery of tung oil was planted in May, from seed supplied by the Forestry Department. The variety was *Aleurites fordii*. Germination commenced in July and was good but some of the plants have since died. About twenty healthy trees remain and these will be planted out at various sites with the February and March rains.

In February a small nursery of oil palm (*Elaeis guineensis*) was planted from seed obtained from Mr. Bell of Mikalongwe. Only one has germinated so far but the seeds are still viable and will probably germinate with the March rains next year.

Natives have been encouraged to plant papaws, mangoes and bananas in their villages but with not much success. They are willing to plant, and do so, but do not take sufficient trouble to water the plants in the early stages or to protect them from goats and sheep.

Grain stores.—In such a bad year as this has been, when the gardens yield poorly giving barely sufficient food for the year, the need becomes obvious for some form of control in the storage and conservation of food-stuffs. A suggestion has been made for a system of control involving eventually the construction in each village of a communal grain store to be under the direct charge of the village headman; such grain store to be filled communally, each villager bringing his quota; each man's contribution to be weighed or measured, and a record kept and receipt given to each contributor. These stores would be fumigated periodically, under personal supervision of the District Agricultural Officer or his Native Agricultural Instructors, who would also be responsible, at least until the headmen were *au fait* with the method and system, for the filling and correct recording of the contents of the stores.

Cotton bulking scheme.—Next year it is proposed to issue *U4* cotton seed to the native cotton growers surrounding the Empire Cotton Growing Corporation Station. The various headmen of the villages in question have been visited and in October came in one afternoon to the Station for a short lecture on cotton cultivation. The proposed scheme was explained to them.

A census is being made of all the growers concerned and duplicate lists will be sent to the seed stores nearby (Kalumbi, Tengani, Port Herald and Chimombo) so that it will be difficult for these natives to obtain *Nyasaland Upland* seed as well. *U4* seed will be issued from the Station; applicants will be made to show their tax-papers which will be marked on receipt of seed.

Other tours.—In addition to district tours a visit was made to the Government well sites near Namalambo Hill, Chiromo, in June, and a report made on the agricultural possibilities of the surrounding country.

A tour was made through the Lisungwe cotton area early in November to report on the cotton uprooting before supplying the district with *U4* seed. A map was made of the cotton area.

PORT HERALD COTTON STATION.

	1927			1928			1929			1930		
	Max temp.	Min temp.	Rain ins.	Max temp.	Min temp.	Rain ins.	Max temp.	Min temp.	Rain ins.	Max temp.	Min temp.	Rain ins.
January			9.53	94.4	74.0	5.84	89.4	71.1	10.55	92.7	70.5	2.28
February	91.8	72.8	2.64	94.7	71.1	2.50	90.0	70.0	7.34	95.9	70.2	1.13
March	87.4	71.4	8.03	91.0	72.6	5.73	89.0	70.7	5.76	93.8	69.9	9.50
April	86.3	69.0	1.81	86.2	67.8	3.37	87.4	65.5	1.03	88.5	66.8	0.93
May	83.7	60.3	0.13	81.7	59.2	0.58	84.4	59.4	0.43	82.3	60.1	0.66
June	77.5	56.2	1.21	84.3	57.7	0.35	83.9	56.8	0.28	79.9	55.0	0.80
July	79.5	57.9	0.89	80.0	54.4	0.46	83.2	55.7	0.18	81.4	57.0	0.29
August	83.3	57.5	0.10	84.8	57.3	0.03	82.5	57.5	1.48	90.3	60.5	0.37
September	90.4	62.7	0.02	93.0	64.8	0.31	96.0	66.8	0.00	92.9	64.7	0.60
October	95.8	68.7	0.41	101.0	67.7	0.00	100.6	71.0	0.00	97.5	65.6	0.02
November	95.2	69.9	1.62	98.5	59.8	3.93	100.5	74.0	2.21	100.6	75.4	0.82
December	94.9	73.1	9.29	94.0	70.0	5.51	94.5	72.3	7.21	97.0	75.6	7.07
Total rainfall. ...	—	—	35.68	—	—	28.61	—	—	36.47	—	—	24.47

	Season 1926-27	Season 1927-28	Season 1928-29	Season 1929-30
Seasonal rainfall Novr.-Octr.		30.08 in.	36.49 in.	26.00 in.
Seasonal notes on crops.	Feb. rain as little as 1927-28 but better spaced and March rains early. Food problem never looked really serious.	Drought end of Jan. and well into Feb. Depressed cereal yield. Famine averted by late Feb. and early March rain. Cotton got bad start.	Pretty regular showers Jan. and Feb. gave cereals wonderful start, and yields were good. Cotton got a good start.	Drought end of Jan. and Feb. No rain after Jan. 21; very similar to 1927-28 season but rain this Feb. fell in very light showers which were immediately lost. Cereals very poor and famine only averted by early March rains. Cotton planted before March got very bad start.*

It would appear from the above experience of four seasons that cotton should not be planted before the middle of February. A fairly safe sowing time, apart from any question of insect control, would be with the first good rain after about February 15th. This is a very loose rule with many exceptions and subject to many modifications.

E. LAWRENCE,
District Agricultural Officer

*Subject to modification Some planted in Tengani area early in January and at Misanje Estate between the sisal did very well indeed. Cotton planted after this early rain and before March rain did not do well.

Annexure C.

Report of the Agricultural Chemist for 1930.

INTRODUCTION.

Owing to my absence on leave during the greater part of 1929, no report was issued for the year, the work done in the early months being included in this report. I returned from leave on February 20th, 1930 and my work has included during the periods covered by this report the following:—

1. Meteorological and soil investigations, principally determination of pH, organic matter and the composition of the clay fraction in climatic soil types.

2. Supervision of field experiments and seed production.

3. Tobacco inspection, being (*a*) close study of the native industry in the Central Province, and (*b*) inspection of estates of European planters on the Government grant.

4. Extension services, i.e. visits to give advice on ridge terracing, type of tobacco to grow, supply of seed of green manuring plants and tobacco, manuring, disinfection of seed, etc.

5. Crop observations, especially on tea.

6. Miscellaneous, being work on (*a*) dips, (*b*) stomach contents, (*c*) poisons, (*d*) soap manufacture.

Investigations of samples and of plants grown from seeds supplied by me were carried out by (*a*) the Imperial Institute, (*b*) the Imperial Bureau of Soil Science, (*c*) Messrs. African Explosives and Industries, Ltd., (*d*) the Imperial College of Tropical Agriculture and (*e*) the Empire Cotton Growing Corporation. The last-named have also greatly assisted in terracing work on the lines previously formulated (1)*. I am extremely grateful to members of the staffs of the above for their kind and generous assistance. With the shortage of staff from which the department has continuously suffered, a wide range of duties has been thrust on me which precludes a close application to laboratory work alone. I also took the opportunity whilst on leave of consulting with members of the staffs of the above institutions and also with those of Armstrong College, University of Durham, where I was able to carry out some further investigations on the characterization of soils. I have to thank the latter for freely allowing me every assistance they could. Tobacco brokers and manufacturers in the United Kingdom were also interviewed and gave me much valuable information.

I carried out the duties of Assistant Director of Agriculture from October 12th till the end of the year.

1. Meteorological and Soil Investigations.

(*a*) The laboratory was enriched in 1930 by the purchase of a portable potentiometer and quinhydrone electrode for the determination of pH values. The latter are of especial use in working out manurial schemes for tea soils. It is found that soils generally in the low-rainfall tea belts have a high pH value, generally necessitating the use in a manuring programme of fertilizers and manures (such as salts of ammonia) which reduce the pH value, i.e. increase the acidity.

Organic matter in soils has been determined in this laboratory by the method of Hardy (2) which has been correlated with the method of Robinson *et alii* (5). The percentage of true organic matter is taken as carbon multiplied by 1.724. Hardy's method is found to yield 78 to 85 per cent. of the total carbon determined by Robinson's method. It will be readily understood that bush fires will yield inert elemental carbon and compounds containing carbon which are very resistant to the action of acids or bacteria. It is considered that Hardy's method gives us a better measure of the effective organic matter and when the ratio carbon (as determined by this method) to nitrogen was determined for a large number of soils it was found that soils in a medium to good state of fertility had ratios varying from 8 to 1 up to 16 to 1, whilst soils in a poor state of fertility had a ratio of less than 8 to 1.

The determination of alumina, iron oxide and silica in the clay fraction of typical soils has yielded some interesting results. The correlation between lateritization and amount of precipitation has been fairly well brought out.

*References at end of Report.

TABLE 1.

Composition of Clay Fractions of Soils.

	No. of soil	Silica	Alumina	Iron oxide	Ratio silica : alumina	Ratio (molec.) silica alumina plus iron oxide.	Mean annual rainfall inches
Cholo lateritic ...	C2 ...	37.9 ...	32.5 ...	11.3 ...	1.93 ...	1.58 ...	56
,, non-lateritic ...	C3 ...	35.1 ...	27.2 ...	12.2 ...	2.19 ...	1.70 ...	
,, v. deep ,, ...	C4 ...	39.6 ...	31.1 ...	11.6 ...	2.16 ...	2.16 ...	
sample Tuanjati non-lateritic ...	T3 ...	37.5 ...	26.3 ...	11.6 ...	2.42 ...	1.85 ...	45
,, non ,, ...	T7 ...	36.6 ...	27.1 ...	12.6 ...	2.29 ...	1.77 ...	
Mlanje lateritic ...	418 ...	25.9 ...	32.3 ...	12.3 ...	1.36 ...	1.08 ...	88
Mlanje lateritic (very close to laterite). ...	418 ...	25.8 ...	31.1 ...	13.7 ...	1.34 ...	1.10 ...	
Zomba lateritic ...	Z1A ...	30.7 ...	31.8 ...	12.5 ...	1.61 ...	1.38 ...	55
,, ,, ...	Z2A ...	32.9 ...	31.1 ...	14.7 ...	1.79 ...	1.38 ...	
,, ,, ...	Z4A ...	32.6 ...	32.8 ...	14.2 ...	1.69 ...	1.32 ...	
,, ,, ...	391 ...	30.6 ...	32.1 ...	9.3 ...	1.67 ...	1.36 ...	40
,, ,, ...	392 ...	34.3 ...	35.4 ...	9.9 ...	1.64 ...	1.40 ...	

Soil classification has been attempted on a study of profiles in numerous deep holes. Horizons except in pedocalic soils are rarely sharply demarcated in Nyasaland, and in numerous types of the red loam groups, it is possible to go down to more than 12 feet below the surface of soils negligibly exposed to soil erosion and find only a very gradual change in mechanical composition, colour and chemical composition of the more important fractions. Of course on stream sides and on the gently sloping lands which go down to broad dambos, it is possible to see outcrops of the concretions of iron and alumina compounds. It is often forgotten that the cutting down of the stream beds and the formation of dambo may, from the point of view of soil and geological science, be comparatively recent. To talk about the shifting of the pan formed of cemented iron concretions in a soil horizon does not seem correct.

Some interesting figures were obtained for pH values of samples taken from various horizons of the red loam types mentioned above in deep holes. It was often found that there was a distinct horizon at which the maximum acidity developed. This was from 3 to 6 feet and it is inferred that this is the horizon at which alumina in particular is mobile. Another interesting point found was that the influence of manganese compounds on the quinhydrone electrode was generally greatest at about 3 feet below soils negligibly exposed to soil erosion.

It is again often forgotten that half an inch of soil may be removed from the surface over large areas of cultivated land or land under shifting cultivation. This means only 72 years before the horizon at which concretionary compounds are found is exposed. In certain cases, again, on steep slopes it may be only half this period which is a very small period compared to the time which is taken for the definite horizons of ferruginous red loam, a chestnut-brown soil or a chernozem to form.

Physical properties of a large number of typical soils have been determined, more especially with a view to correlating the composition of the clay fraction with them but also with a view to correlating erosivity and these properties. Whilst the low figures for pore space and water capacity of numerous Nyasaland soils indicate the ease with which sheet erosion and gullying take place, it is thought that figures for the plasticity index, liquid limit, etc. may give more useful information.

TABLE 2.

Erosivity, Organic Matter and Physical Properties.

Group	Soil no.		Organic carbon C %	Humus or true organic matter, Cx1.724	"True" specific gravity	Pore space %	Water capacity %	On wetting expansion for unit volume of 100 cc.	Clay %	
Lateritic	960 ...	Mlanje wet belt. ...	2.04 ...	3.52 ...	2.30 ...	63.0 ...	74.3 ...	.67 ...	29	Non-erosive
	961 ...	,, ,, ...	1.45 ...	2.50 ...	2.21 ...	59.2 ...	68.5 ...	.96 ...	38	Erosive
	962 ...	,, ,, ...	1.06 ...	1.83 ...	2.28 ...	56.2 ...	56. ...	— ...	41	Erosive
Black earth	589 ...	Dry belt. ...	1.91 ...	3.29 ...	2.54 ...	63.5 ...	62.5 ...	2.69 ...	28	Non-erosive
Red loam	C1 ...	Cholo wet belt. ...	.69 ...	1.17 ...	2.34 ...	45.8 ...	42.7 ...	1.02 ...	17	
	C2 ...	,, ,, ...	.14 ...	.23 ...	2.34 ...	50.5 ...	44.0 ...	2.34 ...	25	
	T5 ...	Tuanjati area. ...	.12 ...	.21 ...	2.49 ...	51.3 ...	49.9 ...	4.01 ...	40	Erosive
Immature grey brown	T3 ...	,, ...	.17 ...	.30 ...	2.52 ...	42.5 ...	40.5 ...	.26 ...	26	
Red loam	791 ...	Limbe high belt ...	1.40 ...	2.43 ...	2.10 ...	45.8 ...	41. ...	2.5 ...	21	

A further factor besides low absorption capacity aggravating the erosivity of many Nyasaland soils is the sharp change from soil to subsoil at a few inches depth. This often coincides with the depth of ploughing. The surface soil may become quickly water-logged with the first rains, and the lower water capacity of the subsoil accompanied by slow percolation leads to a gradual creep, if not an extensive rush, of the surface soil to lower levels. This is often again aggravated by poor ploughing having resulted in an almost impervious upper layer of deflocculated red clay, i.e., a bad "plough-sole".

Organic matter content has a greater influence generally on physical properties than the clay content. Variations both in the composition and amount of the latter are often of far less moment than a slight increase in the organic matter.

The practical outcome of the determinations of physical properties of typical soils accompanied by field trials is the correct spacing and grading of ridge terraces. Since the first publications on the spacing and grades of terrace lines were issued in November and December 1923 (1) much has been learnt about such arrangements. The vertical distance of seven feet between terrace lines for most slopes as given in the latest Rhodesian bulletin (No. 738) on the subject is far too large for Nyasaland soils and in our experience an average of three and half feet is the best vertical distance, varying somewhat with the type of soil and the slope. This is much as was formulated some years ago and it is gratifying to observe that, on a visit of an Irrigation Engineer from Southern Rhodesia in 1930, he generally was converted to agreement with our spacings and grades.

All the fields on the Zomba Plots have now been efficiently ridge-terraced, and the spacing is such that large falls such as 4 inches in 40 hours do not remove any great quantity of soil into the silt pits placed for its reception.

Before this system was properly constructed on a seven-acre field, the following results were obtained in 1929. It must be realized that it often takes four years for an efficient system to reach maturity. The weight of soil removed by erosion and collected in a large pit was 29 tons 13 cwt.* The general slope of the land is 1 in 25.

SEASONAL RAINFALL.

	Inches	Percentage.
.01 to .1 ...	1.38 ...	2.68
.11 to .25 ...	2.89 ...	5.62
.26 to .50 ...	6.05 ...	11.77
.51 to 1.00 ...	11.54 ...	22.44
1.01 and over ...	29.58 ...	57.49

It is obvious from our trials that a vertical distance of 6 feet between successive ridge terraces is far too large for lateritic soils. On certain soil types on a slope of 1 in 20, 4 feet is the limit and great care then is needed during the first few years in the construction of the ridge.

I should like at this stage to make a few remarks about the deterioration of forest soils in Nyasaland as this is a subject which will soon have to receive consideration from administrative officers. There were large areas in Nyasaland a few decades ago which were covered with closed forests. These, largely through the action of native farmers and cattle owners, have passed through the transition stage to definite parkland. Shifting cultivation and annual bush fires have been the chief agencies in this deterioration from the closed forest to the climatic savannah and indeed the soils of the latter in most parts of Nyasaland might be termed degraded forest soils.

It is emphatically asserted by Metzger (4) and other workers that annual bush fires do not harm the closed forest but the transition stage of this to parkland in its varying aspects of high grass-low tree savannah, open woodland, orchard country, acacia-high grass, acacia-desert grass and thorn forest, are in different degrees definitely harmed by these fires and by the destructive clearings of native cultivators.

It is clear that soils once under forest and parkland ultimately become very inferior through encroachments by natives and bush fires, and it must be admitted that in the later transitions leading to grassland there are but few of the indigenous forest trees struggling to establish themselves. With fires, many perish every year and ultimately the grassland becomes not only very inferior from the point of view of animal nutrition in its many aspects but also from that of maintaining a correct organic matter status. Loss of soil by erosion with the first rains which are often torrential downpours is very great. The erosivity of the soils is definitely increased and the degradation can be easily traced by the physical and chemical properties of such soils. That the destructive methods of many tribes in Nyasaland should be controlled is clear and that great extension of agricultural education is necessary will be very obvious. It is hoped that all will be convinced that bush fires in the parkland should be stopped.

The manner in which these soils become degraded must be considered from the point of view of the ferruginous red loams, the true red loams and the lateritic red loams of Nyasaland, three very important groups.

The iron crust which so readily forms under the soils first mentioned is penetrated (in the thorn country, high grass-low tree savannah or wood-land) by the roots of indigenous trees and bushes. These roots are on such soils subject to various diseases which lead continually to a series of openings filled with rotting wood passing through this iron crust. The result is that it consists of a mass of concretions with drainage channels formed at certain definite horizons and at no time can it be termed a plate cemented firmly together. This is formed, unfortunately to relate, over quite large areas a few years after clearing for the limited cultivations of the native. The ferruginous red loams in fact may easily become permanently poor grassland in which it is extremely difficult for any trees to become established, mainly on account of the horizon of cemented iron hydroxides and alumina. The tendency to root disease is increased and there are but few trees which can penetrate firstly the water-logged horizon above the crust and secondly the crust itself. White ants which follow the depredations of root disease are often blamed for the extreme inability of exotic trees like blue gums to flourish when transplanted on such soils.

The two main soil groups of red loams are generally to be found on the steeper slopes of the Shire and other highlands. Leaching is proportionate to slope and types and series of the groups can generally be termed fairly fertile soils in fair phyical condition on clearing from forest or

* Nearly ¼ of an inch of surface soil.

woodland. There is, however, a great tendency to erode under cropping and a few years in native cultivation may see abandonment to grassland and annual bush fires. A common factor in the deterioration of these soils is the sharp change which usually occurs between the upper good humic layers and inferior subsoil. The latter is easily puddled or deflocculated and may become impervious to water. The upper surface soil then easily becomes waterlogged and, with little more rain, starts on the steep slopes to move down hill. Ploughing of these soils when their moisture content is far removed from the optimum may lead to such condition of the subsoil that erosion is accelerated.

Furthermore, a very serious aspect of the bush fires is that the mineral contents of the grass etc. are rendered soluble and are either leached to much lower horizons or carried in surface waters to inferior ferruginous flat lands or to dambos. The latter are depressions in the hilly and rolling country and the soils are in a good condition from the point of view of humus but are often waterlogged and deflocculated.

The baking of the surface layers of all these soils by bush fires again may lead to an impervious thin crust from which the first torrential rains may remove very large quantities of unburnt organic matter, charcoal and soluble ash. The number of useful soil organisms is reduced. As against the soils of the closed forest and open wood-land, those of the low tree savannahs are harmed in a much greater degree by the annual bush fires. Encroachments into the former are in many cases healed rapidly, but the absolute stoppage of bush fires must be ensured for some years before minor regeneration is at all apparent in the latter. The work of a planter near Zomba is very interesting in this aspect of the problem. By very early burning or complete stoppage of annual bush fires, he has in a few years achieved major regeneration of woodland and improvement of ferruginous red loams. Forest and woodland also with total or partial canopies by breaking the force of torrential downpours do in varying extent prevent rapid soil degradation.

It is maintained that vegetation has a great influence on soil profiles and that a change in vegetation, such as the destruction of forest and removal of the deep root zones of woodland, means eventually a very different soil profile. Doubtless such factors as run-off of water from the surface and the lowering of the water table in the drier parts of the years often have as great an influence as the climate as a whole and often lead to a permanent deterioration in physical and chemical properties.

(*b*). Meteorological observations have been intensified during the year and it is hoped to prepare a more accurate rainfall map of the Protectorate with the co-operation of many planters to whom I have issued books for keeping records. That it is necessary for soil workers to study climatic records carefully is now well known. A quotation may be of interest. Professor Glinka says: "Is it, for instance, a matter of importance whether the soil is derived from granite or diabase? No, for researches in the field have shown that under similar external conditions all the above mentioned rocks give uniform soils. 'While, on the other hand, we know that, under this influence of dissimillar external factors, soils differing profoundly from one another may be produced from the same type of granite". Professor Leppan and others, in studies of agricultural development and crop adaptation, are of the opinion that a thorough study of soils and climate is necesary but a detailed treatment of the geology of a country is not of sufficient relevance to warrant inclusion in such enquiries. Much money has been lost in the past in Nyasaland in attempting to grow commercial crops in areas where the climatic conditions are far removed from those pertaining in other parts of the world where the same crops are successful. This is preventible and there is no reason why it should not be prevented.

2. Field Experiments and Seed Production.

(*a*) Some interesting results have been obtained in the renovation of worn-out land. Plots were laid out for some time on Dr. Garner's replicated parallel arrangements but now, although many of the previous plots are being continued with the same treatments, these experiments are being carried out on the statistical basis of Dr. Fisher, there being again as many replications as there are treatments. Randomized blocks are laid out. They may be very simple types of lay-out but they give a valid estimate of error and give a better clue to results which might have suffered from soil variations in the plots. Anything less than such replications and arrangement in experimental work will fail to get out of the data results of value.

It is quite obvious to date that resting land even for a large number of years does not restore it to its original state of fertility under forest growth, so long as annual bush fires followed by torrential downpours are allowed full play without any system of ridge terraces or other arrangement for preventing erosion.

One of the main factors influencing fertility of soils under closed forest is the withdrawal of all elements necessary for growth from the lower horizons and their accumulation in the surface soil. Clearing for cultivation first means excessive leaching if nothing else and the surface soil soon becomes impoverished of these elements. In addition other factors mentioned above prevent, after abandoning the land, the growth of the superior mantle of vegetation which the soil once possessed. There is very little accumulation in the top-soil of all the elements necessary for growth and good crops almost invariably cannot be obtained on the second clearing. This is becoming a serious matter when the denudation of the country is proceeding apace and the land available for shifting cultivation is becoming less and less every year. Rotations and green manuring, unless very deep-rooted crops are grown, have shewn very little effect on many types of degraded forest soils in increasing fertility over several years.

As a result of experiments on these leached soils and our preliminary trials, it must be conceded that, in any system of manuring on similar soils, it is necessary to consider the magnesia, lime and sulphur very often as much as the potash and phosphates. The use of highly-concentrated fertilizers like urea, diammonphos and phosphate of potash have in Nyasaland as in America often given very poor results owing to soil deficiencies such as lack of sufficient available magnesia. Due regard must be had to the supply of such elements. It is pity that so many planters pin their faith entirely to concentrated fertilizers which in many seasons give very poor quality tobacco.

Experiments arranged on a proper basis have shown that potash or phosphates are rarely by themselves limiting factors on growth. For example, muriate and sulphate of potash, compared at the Zomba station as fertilizers for tobacco, gave no significant increase in yield over each other or over the returns from plots treated with no potash but receiving the basal dressing of nitrogen. Each treatment was replicated twelve times.

Another experiment on the same type of soil studying the effect of lime and double superphosphate, using soya-beans as the crop, gave the following results:—

MEAN WEIGHTS: LB. PER 1/40TH ACRE.

	Green		Seed
A	105.2	...	15.8
B	121.3	...	16.4
C	111.9	...	16.4
D	107.6	...	16.6
Standard deviation	15.4	...	4.5
Standard error of differences of means ...	10.9	...	3.2

None of the differences are significant. Treatments were:

A. No minerals

B. Lime 2000 lbs D. Superphosphate 200 lb/ acre

C. Double Superphosphate 200 lb/ acre and

D. Lime 2000 lb/ acre.

The yields of tobacco obtained in 1930 and the organic matter found in the soil of certain rotation plots are interesting.

YIELDS OF TOCACCO PER ACRE; GREEN WEIGHTS.

	Series B.		Percentage organic matter in soil (carbon 1.724).
Continuous tobacco plots 1926-1930	5730	...	1.41
do do do do do	5400		
Sunn hemp 1926	7103	...	1.60
and in 1928	5960		
Velvet bean 1926	5820	...	1.66
and in 1928	5770		
Continuous tobacco plots	5090	...	1.36
	5250		
Soya bean (1926 and 1928) plots	5150	...	1.56
	5700		
Maize 1926 and 1928 plots	5200	...	1.70
	4700		

These plots all grew tobacco in 1927, which showed the soil to be uniform at that time (3).

The plots were not well planted, owing to my absence on leave, and root-gallworm attack interfered with the growth of some plants. The results show, however, that green manuring by itself is not so effective as it is often reputed to be. The results were calculated to 4,000 plants to the acre. The experiments on these poor fields must be continued for several more years, but there is strong evidence that organic manures supplying all elements of plant food are necessary in large quantity on lateritic soils for regaining good fertility. These experiments will have to be extended to other impoverished types of important soil series.

Furthermore, the severity of attack of certain diseases on both tea and tobacco is related to poor or good methods of treating the soils growing these crops. There is a great number of misconceptions concerning the behaviour of the tea bush under certain soil conditions. Poor growth may be attributed to a certain influence entirely when other major factors are really responsible. To take one example, reference is often met with in the literature to the harmful effect of lime and it is said that applications of 1 ton of lime or 500 lbs. of wood ashes are excessive. A soil reaction study was made this season to show that even large applications of lime do not

harmfully affect the reaction of tea soils. The lime was applied in December and the reaction determined after the wet season. The results were as follows:—

Plots		Application		Reaction pH values.
A.	average of five ...	no lime	...	5.41
B.	„ „ ...	806 lb/acre	...	5.71
C.	„ „ ...	1,612 „ „	...	5.96
D.	„ „ ...	2,420 „ „	...	6.08
E.	„ „ ...	3,226 „ „	...	6.14

Let us examine a few more results of liming experiments on tea soils. It must be agreed that the optimum pH value of soil for tea lies between 5.3 and 6.5 and that the loss from a fertile soil of lime by leaching under a good tea rainfall is 200 lb. per acre per annum. The results of liming trials in Ceylon between 1904 to 1911 when examined statistically showed that, in four experiments, one showed lime to be slightlv and definitely beneficial, and one showed it to be slightly and definitely harmful. The other two experiments gave indefinite results. In 1928, the addition of lime at the rate of 5 tons per acre had a marked beneficial effect on the serial growth of seedlings in Ceylon and further experiments showed that, on soils with an initial pH value of 5.8, applications up to 10 tons per acre, provided the neutral value of 7 was not passed, had no harmful effect on growth.

Nearly all our types of soils in the high rainfall areas show very low figures for exchangeable lime and pH values. Some lime is leached out every year and soil indicator plants like tobacco often show symptoms due to magnesia and lime deficiency (3). It is considered therefore that ground magnesian limestone at small rates in a definite manuring programme will prevent any possible hunger for these elements and is likely to be as profitable as many highly-concentrated potash and phosphatic manures.

(*b*) Several tons of seed of plants recommended by the Department as cover crops and green manures were issued during the year. O-too-tan Soya bean and bush jack bean (*Canavalia*) together with cuttings of *Indigofera endecaphylla* constituted the greater part of these consignments. 77 lbs. of tobacco seed were issued by the Department, besides which all the natives in the Central Province have sown nurseries with the *Western D. N.* variety, seed of which supplied from the Zomba station has been multiplied by the Native Tobacco Board.

3. Tobacco Inspection Work.

The native industry received my close attention in the latter part of the year and I attended a conference of buyers arranged by His Excellency the Governor.

Whilst on leave during the season 1929/30, I was unable to inspect the estates of planters who received the Government grant, although I did so in the season 1928/29 and am now able to do so. It is obvious that various faults prevent these planters obtaining a good crop. In many cases their seed supply can be improved. Many are keen on ridge terracing and correct programmes of manuring and rotations but lack of skill prevents them correctly laying off the former and their manuring programmes can be worked out to give better results.

It must here be categorically stated that all these estates should be ridge-terraced and that it should be impressed on all that the greater proportion of their fertilizer and green manuring represents so much money thrown away in the absence of a system of soil conservation.

4. Extension Services.

Whilst it may not be thought a part of my duties, I considered that the slowness with which ridge-terracing was being adopted warranted my instructing certain planters in laying these out with proper levelling instruments. Doubtless the closing of the Government farm in 1923 prevented useful demonstration work, as I had worked out a scheme for ridge-terracing there. Furthermore, I must thank the farm managers of the Imperial Tobacco Company, the Nyasa and Rhodesia Estates and the Native Tobacco Board for initiating trials in 1930 on various soil types.

I travelled 4,000 miles during the year on this and other soil survey work and read papers to the Nyasaland Tobacco Association and the Tea Research Association. As with most farmers, however, demonstration is better than talk and the steps being taken to initiate experimental stations in different agricultural regions of Nyasaland are welcome and these stations should be of great value to the various types of farmers concerned.

I have pointed out that a continuous soil and crop survey is necessary for a definite type classification of Nyasaland tobacco. These definite types, grown from approved varieties, should possess that distinctive colour, texture, burning quality and aroma which is usual in tobacco grown on the soils, at the elevations, and under the climatic conditions upon which our type classification is based. I ask again whether we are still to produce tobacco which can only be used as a small percentage in blends, or definite and desirable types which will be sought after and have a definite supply from year to year. The question of tobacco seed supply requires to be put upon a sound basis.

5. Observations on Tea.

It has been remarked that misconceptions exist as to the many major and minor causes which may cause a tea bush to develop well or flush badly. Mr. Tunstall of the Indian Tea Association has recently written me to the effect that "very many tea diseases in N. E. India are the result and not

the cause of lack of vigour. The more I learn the more I am convinced that the most satisfactory way of dealing with disease is by treating the host plant. Our work in this respect has in many cases led to great improvements in the course of which the disease concerned has become insignificant. Direct treatment of fungus disease is very frequently more costly than the losses due to the fungus concerned. In our department we look on the killing of the parasite as of little importance compared with increasing the vigour of the infected plant. In the case of many of our common diseases we can force a crop through an attack of disease by cultural improvements and it has frequently happened that a severe attack of a disease was really a blessing in disguise and marked the beginning of improvement in many directions. The disease is frequently a symptom which helps us to diagnose a defect in the conditions of growth of the host plant". I agree with Mr. Tunstall's remarks concerning the influence of conditions of growth. The absence of a system of soil conservation and serious depletion of the soil organic matter has in the past reduced the vigour of numerous tea gardens in Mlanje. Little or no attention has been paid to manuring and it will be, in certain cases, many years before the soil regains the fertility it possessed on clearing even with an intensive programme of manuring and the institution of ridge terracing with correct gradients for reducing erosion to a minimum. It is highly probable that yellows of tea is ameliorable and other troubles are preventible when the above systems are instituted.

It is interesting to observe that the above disease invariably occurs on the Zomba lateritic soil under certain conditions, and that a root fungus (*Rhizoctonia bataticola*) has been found on tea plants attacked with this disease on the Zomba plots. The experiments on fertility which are being continued and the results of which are presented above will have a distinct value on lateritic soils of very similar types in Mlanje and Cholo. Time precludes the carrying out of extensive experiments on the Mlanje tea soils but it is thought that the precepts of 1923 (1) on soil conservation should have been more closely followed.

The lack of a proper farming sense is seen in the demands which are frequently presented for certain chemical determinations on soil samples and in the large bills which are often seen in connection with such determinations. The limited value of analyses of tea soils has been pointed out (3) by many authorities and lately in *The Tea Quarterly* of the Ceylon Tea Research Institute for November, 1928. Aspects of other crops need not be mentioned here although others, especially coffee, have been the subject of close attention.

6. Miscellaneous.

Miscellaneous investigations and routine work have included the usual supply of deci-normal iodine and starch gloy to Veterinary Officers, the analyses of twelve stomachs (including one human) for poisons, and of numerous fertilizers, waters and limes.

In conclusion I would like to draw attention again to the numerous duties which are likely to be thrust upon an Agricultural Chemist and that the time is surely now opportune for field work alone to be put on a really sound basis. The tea plant in N. E. India once was the subject of investigation by one man, who dealt with such diverse aspects as soils and manuring, mosquito blight, ferment of the tea leaf, red rust, green manuring, blister blight, pruning, and the red slug caterpillar. Such work may be directed by a single and special brain, and it may still be thought that one scientific investigator can deal with such a range over a large area, but unfortunately such efforts may lead to few results of significance.

Publications due to me during the years 1929/30 were in the Agronomic Series:—

Circular No. 4—Conditions for tea growing.

Bulletin No. 3—Studies of three important soil series.

Bulletin No. 4—Comparison of tea soils and climates in various parts of the world and "Green manuring: its practice and value", being a paper read to the Nyasaland Tobacco Association. A report on the West African tobacco market was also issued. I also read a paper entitled "Weather and tobacco" to the Conference of Empire Meteorologists in 1929.

I have referred to the following publications in the foregoing report:—

1. Dixey, Clements and Hornby. Destruction of vegetation, its relation to climate, water supply and soil fertility. Bulletin No. 1 of 1924.

2. Hardy, F. (1929). Determination of soil organic matter. Journal of Agricultural Science XIX, 727.

3. Hornby, A. J. W. Annual Report for 1927.

4. Ramann, E. 1918. Classification of soils.

5. Robinson, McLean and Williams, Rice (1929). Determination of organic matter in soils. Journal of Agricultural Science XIX, 315.

A. J. W. Hornby,
Agricultural Chemist.

Report of the Entomologist for 1930.

The work of the division during the period under review has unfortunately been somewhat disconnected. On returning to headquarters late in 1929 from a prolonged visit to the North Nyasa district, a considerable amount of urgent laboratory work and the preparation of reports had to be carried out, with the inevitable result that the early part of the 1929-30 planting season was not observed.

Travelling.—Besides the normal annual travelling in connection with visits to European estates, a period of one month was spent in the Misuku area of the North Nyasa district investigating the possibility of establishing a native coffee industry there. A separate report on this subject was submitted.

Lectures.—Two lectures were delivered in the middle of the year. The first to the Nyasaland Tea Research Association and the second to the Nyasaland Tobacco Association. Arrangements were made at the request of these Associations to have the lectures printed and circulated to members, but much unavoidable delay was experienced, particularly in the latter case, owing to the impossibility of getting even the simplest diagrams reproduced locally. Without diagrams the printed lecture would have been valueless.

Tobacco.

Aphis or green fly (*Myzus persicae* Sulz.).—This pest was unusually serious during the season 1929-30. It was unfortunate that, for the reasons stated above, the early parts of this tobacco season could not be observed and so it was not possible to learn, from any reliable authority, if the infection started in the seedbeds although this seemed to be the most reasonable assumption. Towards the end of January tobacco in the field, mainly in the Shire Highlands, was so badly infested with the insect that artificial control measures could not be economically employed and damage to the leaf was inevitable. During the present season, 1930-31, proof has been obtained that the pest does commence in the seedbeds. Some apprehension has been expressed that this insect may be increasing in status as a virulent pest of tobacco in the Protectorate, but there is no real ground for such a view.

As far as local outbreaks are concerned, there is little doubt that the climatic conditions of each particular season are the main factors which determine whether the insect will be of importance or not. In 1925 and 1929 the aphis was to be found on tobacco in fair numbers in the month of March, and in the first of these two years the proportion of individuals attacked by internal parasites was fairly high. Normally these parasites, together with such predaceous insects as ladybird beetles and their larvae and the yellow-green, worm-like grubs of the hover flies, are able to keep the tobacco aphis in check. But in seasons when an early rain is followed by a spell of dry weather, as occurred in both the past and present seasons, it seems that the aphis gets a rapid start before these natural enemies can exert any real controlling influence and, owing to the extreme rapidity with which the aphis can multiply, given suitable conditions, quite a short period of such conditions is sufficient to lay the foundation of a heavy infestation. For example, by the end of January 1930, these natural enemies were much in evidence in the fields but the aphis infestation was, by that time, so heavy that they did not appear to be having much effect. Observations during the present season, 1930-31, seem to show that openly-placed nurseries are less liable to infection by aphis than those situated in hot, sheltered corners on a stream bank and surrounded by thick vegetation. There is abundant proof that proper aeration and ventilation of seedbed sites, coupled with only a moderate thickness of sowing, are by far and away the most important factors in the development of good, healthy tobacco nurseries. Continuous watch on such seedbeds at the Zomba Experimental Plots revealed no aphis during the whole of the 1930-31 season (though it was abundant in the fields the previous year), whereas neighbouring seedbeds under the reverse conditions were found to be badly infested by December. From what has been said it is obvious that serious damage by the pest in the field is likely to occur only if infection takes place originally in the nurseries. Hence the great importance of employing artificial methods of control at this period of the plant's existence. Measures against the tobacco aphis must consists in the application of a *contact* insecticide, one which kills by touching or wetting the insects themselves. The most efficient of such insecticides for this particular purpose is undoubtedly a nicotine spray, using either a proprietary preparation or an extract made from tobacco scrap containing a fair proportion of leaf. Commercial powder called *Katakilla* can also be confidently recommended. A plain soap solution may also be employed, but in this connection it is important to emphasise the fact that it is essential to use a good quality soap or serious scorching of the foliage will most certainly result. Experiments made in dusting aphis-infested tobacco with the local fish-poison bean (*Tephrosia vogelii*) in powder form proved that this material was not satisfactory as a contact insecticide. It is possible that as a liquid spray, with the addition of a little soap, it would be more beneficial but experimental work on this line has not been possible. The powder, however, produced a very rapid wilting effect on the tobacco plants, though complete recovery was made in a few days.

Mosaic.—The relationship of the tobacco aphis to the transmission of mosaic disease seems a little obscure. Work in England and America has proved that this aphis does not transmit mosaic from tobacco to tobacco but can transmit certain virus diseases from other plants to tobacco[1]. During the 1929-30 season, when mosaic was very prevalent in conjunction with the aphis in some areas, all attempts at the Experimental Plots to get mosaic transmitted from diseased to healthy plants by the aphis failed, but rapid development of the disease occurred in a healthy leaf on which a diseased leaf had been lightly rubbed. When mosaic occurs, therefore, the minimum possible amount of the handling of the plants should be permitted.

In the Annual Report for 1929 (p. 15) mention was made of a small Capsid bug (*Engytatus volucer* Kirck.) which, being a sucking insect, was considered a possible vector of mosaic disease of tobacco. Since this was written, work on this insect has been carried out in Southern Rhodesia[2] and proof obtained that it does not transmit tobacco mosaic, but that it does produce a condition of the plant called "crinkle" in that colony, which seems equivalent to the condition known as "cabbaging" in Nyasaland.

Root eelworm (*Heterodera radicicola* Greef).—Records of the temperatures of the soil of tobacco seedbeds have now been obtained over two complete nursery seasons. These records prove that immediately the shading and watering of the seedbeds is begun the soil temperature to a depth of some twelve inches *at once* drops to within the limits of the most suitable temperatures for the development of eelworm[3] (in which range of temperatures the optimum for root development of a tobacco plant unfortunately also lies) and for the most part remains within these limits, not only for the whole of the seedbed period but even well on into March or April if plants are left thickly in the beds. Thus even after the shades are permanently removed the growth of the plants themselves may be sufficient to keep the soil at the temperature which is most conducive to rapid eelworm development. Diagrams illustrating this effect have been included in the printed copy of the lecture delivered to the Nyasaland Tobacco Association. There is still a great deal of information to be obtained as to why some seedbeds become badly infected, whereas others under seemingly similar conditions remain free. But the above records emphasise the importance of reducing the length of time tobacco plants remain in the seedbeds and the necessity for removing all surplus plants as soon as possible.

Nyerere ants (*Pheidole megacephala* F.).—Although it is difficult to see how the method can be employed under local conditions, it may be of interest to put on record here the following measure adopted in Java to prevent the removal of seed from tobacco seedbeds by an ant, known in that country as the red tobacco ant, which, however, is not identical with the *nyerere*. "A piece of mosquito net is stretched over the bed and sprinkled with water so as to be pressed on to the surface of the ground. This prevents the ants from reaching and removing the seeds. The net is left for about four days until germination starts. Old netting with holes is quite effective".[4]

Cotton.

On returning from the North Nyasa district at the end of 1929, an attempt was made to find some readily discernible difference between the immature stages of pink bollworm (*Platyedra gossypiella* Saunders.) and those of *Mometa zemiodes* Durrant. The pink bollworm material available for comparison was unfortunately very limited and the larvae were completely discoloured. Unless, however, there is some distinct colour difference between the larvae of these two moths, with the exception of size when full grown, the only real disparity between the two appears to be in the setal arrangement, particularly on the third, eighth and ninth abdominal segments, and the shape of epipharynx. The mandibles of the larva of *M. zemiodes* appear to have indications of an additional tooth on the inside but it is by no means pronounced. As regards the pupæ, size again appears to be the only marked difference, those of *M. zemiodes* being slightly smaller than those of pink bollworm; the cremaster of *M. zemiodes* may be slightly more re-curved than in the case of pink bollworm, but the difference is small. As stated in the previous Annual Report, where such larvæ and more particularly pupæ are found in seed cotton, unless critical microscopic examination is possible, the only sure proof of identity seems to be by breeding the moth.

During the visit in May and June to the North Nyasa district the opportunity was taken of investigating cotton growing in the immediate vicinity of Karonga. No signs of pink bollworm were to be found, but it was early enough in the season to make such a result not unexpected.

Tea.

Termites.—It was hoped that further information could be obtained as to the effect of using dry Paris Green dusted closely around and on to young tea plants attacked by white ants. The work, however, could not be followed up with the close observation that was desirable and it can only be stated that there were indications that this measure was in many ways successful and deserves further consideration. In certain preliminary trials, after nearly five months from the time of treatment during which period considerable rain had fallen, only 18 per cent. of the bushes in a treated block of tea (a total of 133 bushes) had succumbed entirely to white ants, whereas in a similar block, untreated, there was only 50 per cent of the original bushes left. An important point in using this measure is that the Paris Green must be put right against and on the stem of the plant; it is useless if placed on the soil in a ring around the plant as the termites do not then come in contact with it.

1. R. A. E. XVII. p. 282; XVIII. p. 499, etc.
2. B. E. R. XXI. p. 169.
3. vide Godfrey. Jrl. Agric. Res. XXXIII, 3, 1926.
4. R. A. E. XVIII. p. 59.

Aphis (*Toxoptera aurantii* Boyer.). —This "black fly" was unusually prevalent during the season and for probably the same reason as in the case of the tobacco aphis. It need not be feared that the aphis seen on green manures planted among tea will affect the tea bushes. This latter is a different species, *Aphis laburni* Kalt., which seems mainly confined to leguminous plants, whereas the aphis on tea and coffee has, as its main additional food plants, nearly all kinds of citrus trees.

Coffee.

Cameron Bug (*Antestia variegata* Thunb.).—Very considerable damage was done to the 1930 coffee crop by this insect in certain districts, and coupled with this attack there was found to occur in some bushes a very pronounced vegetative growth and a complete absence of crop. On these bushes, the shoots were marked by abnormally short internodes having a distinctly lumpy feeling to the touch of the fingers and a proliferated growth of secondaries or tertiaries from each node. This condition corresponded fairly closely with the description of the result of a severe *Antestia* attack on coffee given in several numbers of *Der Pflanzer*. It did not seem, however, that this condition was always associated with the presence of Cameron bug. In particular a Jassid (*?Gubela bellicosa* Dist.) was widely distributed on bushes having these symptoms. By caging specimens of the insects on apparently healthy coffee trees proof was obtained that the Cameron bug was alone responsible. It must be concluded, therefore, that there had been considerable activity on the part of this pest during the previous year, which had passed unobserved.

Although spraying with a sweetened sodium arsenite solution seemed to give encouraging results, a very large number of beneficial insects, in particular hover flies (*Syrphidae*), were killed by the same means. As far as comparison between the results of spraying and those of hand-collecting was possible, it appeared that one spraying would, in 24 hours, kill two and a half times as many individuals of the pest as could be collected by a gang of 25 children in a day's work. The practical advantages and disadvantages of the two systems seem to be about equal. Spraying on anything of a large scale under local conditions is always a difficulty; moreover, as has been found in other countries, only a very slightly stronger solution than that recommended, i.e., $\frac{3}{4}$ oz. poison to 4 gallons of water, is apt to produce serious scorching, and if the spray is not applied to the bushes in the correct manner, always a difficulty where native labour is concerned unless constant European supervision is possible, the value of the work may very largely be lost.

Against hand-collecting must be set the fact that children, who are normally employed for such a purpose, cannot reach the upper parts of large bushes, where the insect is most frequently to be found. Speaking generally, it may be said that under local conditions hand-collecting, particularly in the early months of the season when eggs should also be collected and the parasites hatching therefrom liberated, is probably as of much value as spraying with a poisoned bait, this latter method being resorted to if the pest appears to be getting out of hand.

Investigation by means of automatic recording machines into the temperature and humidity conditions of differently sited coffee gardens which appeared to show some variation in intensity of attack by this pest has been commenced.

Stem borers.—It may be of interest to point out that when coffee bushes attacked by the white stem borer (*Anthores leuconotus* Pasc.) are uprooted, it is essential that they should be burnt unless it is absolutely certain that living grubs are not still present in the stems. The simple action of casting on one side bushes so attacked does not encompass the death of the grubs and in due course the adult beetles will hatch therefrom.

The statement has been heard that the grubs of the white stem borer of coffee have been found in the stems of *nandolo* (*Cajanus indicus*) and in *Mimosa*. Although *nandolo* might quite reasonably be a host plant of this beetle, the opportunity has not occurred for any specimens of the grubs from this plant to be investigated by the Entomological Division, but the one specimen from *Mimosa* that was forwarded was, most emphatically, *not* the same as the coffee borer.

As regards the redheaded stem borer (*Dirphya nigricornis* Oliv.) the grubs of which bore down the full length of the stem, making a series of holes to the exterior whence drops the sawdust-like frass that can be seen on the ground around the bush, it can again be recorded that in every case where this pest has been present the coffee bush attacked was found to have a badly bent tap root.

Scale insects.—General observations show that the coffee plant under local conditions does not suffer to any extent from serious attack by these insects. If this crop is adopted as a subsidiary crop in the wetter districts of Cholo and Mlanje it is reasonable to suppose that scale insects may be found more in evidence. Up to the present most of, if not all, the scales found on coffee are parasitized by small Chalcid wasps to a very considerable extent and also suffer from the activities of numerous predaceous insects.

The most interesting record during the year in this connection was the presence of coffee mealy-bug (*Pseudococcus lilacinus* Ckll.)[1] in the Misuku Hills. It was only found in this area in the rich, damp hollows where the micro-climatological conditions might be expected to favour its development. It was attended by an ant (*Pheidole megacephala* F.) but was not widespread.

Irrigation.—Though irrigation is not practised locally on any large scale as an integral part of coffee cultivation, where flooding of a garden has been utilized in September to augument the soil moisture and promote flowering and the setting of the flowers a quite astonishing collection of the larvae of surface beetles (*Tenebrionidae*) and of cockchafer beetle adults (mainly *Trochalus* and *Autoserica* spp.) was made a few days later around the stems of the bushes so flooded. The

1. This determination requires authoritative confirmation.

Tenebrionid larvae (or wireworms) consisted mainly of a species of *Zophosis* (not *agaboides* Gerst.) and *Gonocephalum simplex* F., which composed 57 per cent. and 34 per cent. respectively of the total collection of some four hundred grubs.

This observation confirms the opinion that a season with an early rainfall is conducive to an early development of insect activity in that season, and planters of any crop should, under such circumstances, be on the watch for any outbreak.

Sorghums.

Mites (*Acarina*).—It was observed at the Zomba Experimental Plots in January that types of Sorghums imported from Europe suffered very severely indeed from attack by a mite similar to red spider, while the local plants alongside remained comparatively free, a clear indication that an imported, unacclimatized plant may be very susceptible to indigenous pests.

The mites and their eggs were being preyed upon by the larvae and adults of two species of ladybird beetles (*Scymnus trepidulus* Weise. and *Scymnus* sp.) and also by the larvae of a small two-winged fly (*Agromyzidae ?*)

Miscellaneous.

Swarming caterpillars (*Laphygma exempta* Wlk.)—A very widely distributed outbreak of this insect occurred during the latter part of 1929 and the early months of 1930, from Port Herald to Ncheu. Apart from some damage to young maize, the caterpillars confined themselves mainly to grass and, in Zomba at any rate, were devoured in enormous numbers by crows. Pupation occurred towards the middle of February and the adult moths hatched during the beginning of March. A second brood of caterpillars did not develop to any large extent. This particular swarming caterpillar does not appear to attack tobacco. The only previous record of it in the Entomological Division is in May 1915, when it is reported to have occurred on teff grass, sweet potato and wild grasses. It is not the same species as swarmed on tobacco and did considerable damage in January 1923 (*L. exigua* Hubn.). Nor is it the same as the caterpillar that can be found in swarms annually, about May, on the higher slopes of Zomba mountain. The latter, from which moths failed to hatch in captivity, has the native name of *mbalaungu* and is utilized as a food by the natives, whereas the true swarming caterpillars are not so eaten. Where these swarming caterpillars are found in the vicinity of young maize and so forth, every means of crushing and destroying them should be adopted at once, or they can be prevented from reaching the cultivated area by a trench in which the earth on the face of the side nearest the crop is kept loose and crumbly, as they may migrate to the young crops and by sheer force of numbers strip the gardens bare.

Greenfly.—During the work carried out on the tobacco aphis a number of specimens of aphides from a variety of plants was examined. It has several times been reported that the tobacco aphis has been found on other plants, *nandolo* for example, but although some four different species of aphis have been separated from those found on this bean, the tobacco aphis has not been among them. Up to the present, though neither the possible host plants nor the different aphides to be found have been exhausted, the tobacco aphis has not been taken from any other plant, though it will undoubtedly be found on several.

A list of the plants examined and the aphides found thereon up to date is given below. These insects vary so much in colour within the species that it must not be assumed that this is sufficient to separate the different kinds, and several species have reddish eyes besides the tobacco aphis; the colour notes given in the list merely refer to the general appearance of the aphides in mass.

Plant.	Greenfly.	Colour.	Month.
1. Tobacco	*Myzus persicae* Sulz. ...	Green, grey-green ...	December
		eyes red ...	January
			March
2. Cajanus indicus (*nandolo*) ...	*Aphis laburni* Kalt. ...	Black or dark ...	May
	Macrosiphum nigrinectaria Theo. ...		
	M.? neavei Theo. (1 species undetermined) ...	Black ...	September
3. Cotton	*Aphis gossypii* Glov. ...	Green ...	March
	Macrosiphum dahlifolii Theo. ...	Black ...	March
4. Sorghum	*Aphis* sp. ...	Dark green ...	January
5. Wheat	*Macrosiphum* sp. ...	Light green ...	June
6. Beans (among tea) (kungudzu vine) ...	*Aphis laburn* Kalt. ...	Black or dark ...	January
			December
7. Persian Lilac (shoots from stumps)	*Aphis leguminosae* Theo. ...	Light to dark green ...	December
8. Tea, coffee and citrus ...	*Toxoptera aurantii* Boyer. ...	Black ...	All
9. Agave	*Cerataphis lataniae* Boisd. ...	(Scale-like in shape)	June
10. Weeds: leguminous			
Compositae	*Aphis leguminosae* Theo. ...	Light to green ...	December
Labiatae	*Macrosiphum dahlifolii* Theo. ...	Black ...	June

Fruit-piercing moth (*Egybolis vaillantina* Stoll.).—This vividly coloured moth, steel-blue with an orange head and an orange band across the base of the wings, appears to be commonly distributed in the Lower Shire and Lake Shore areas. Some damage to citrus fruits was reported from the latter during the early months of the year.

Conclusion.

If consideration be given to the many and varied agricultural operations that the planter in a tropical country has to carry out to ensure the successful production of whatever crop he is growing, it is not altogether surprising that the matter of dealing with insect pests gets pushed into the background until such time as the insects draw attention to themselves. Such matters as prevention of soil-erosion, preservation of soil fertility, the use of artificial and green manures, type of plant to suit the locality and so forth, claim so much attention that "the worm i' the bud" is, more often than not, completely overlooked until too late.

Where large areas are cultivated in one crop, artificial measures of insect control are too frequently beyond application on an economic scale and the chance of "getting a crop in spite of the insects" must be taken. For this reason the work of the Entomological Division has been concentrated more on general methods of cultivation and field and plant sanitation than on the development of spraying or other measures. There are occasions, however, when the *immediate* application of an insecticide may be the means of saving the crop and still remain within the bounds of reasonable expense. But this can only be accomplished if the necessary chemicals and the means of applying them are ready to hand. A mere two or three days' delay in obtaining the requisite poison may easily mean that the pest will have done the maximum amount of damage and have begun to die off, and the application of an insecticide *then* will not be an economic proposition. Another important point is that, in the majority of cases, unless an insecticide or fungicide is properly applied under pressure, it will be of little or no value. Every estate, therefore, no matter what crop is being grown, should be equipped with supplies of simple insecticides and fungicides, such as lead arsenate and/or Paris Green, Bordeaux mixture, nicotine or the materials for making a tobacco extract, and lime sulphur in the cases of perennial crops. In addition there should be a machine or machines for applying these materials, even if they are just two or three ordinary garden syringes provided they are good ones.

When it comes to dealing with native agriculture controlled by European interests the problem is one not easy to solve. As a case in point where some action is imperative the tobacco aphis may be quoted. As was said at the beginning of this report, an open situation for a seedbed is better in every way than an enclosed one, and much good might be done by intensive propaganda on this subject among the native growers. But it is obvious that the ideal conditions cannot always be obtained and the tobacco aphis must be regarded as an ever-present potential pest of native tobacco. *If* the means are available, its control is simplicity itself. *Therefore* the European interests concerned must decide whether the product they wish to obtain is worth the cost of the provision of those means.

It is fully realized that present agricultural conditions render it imperative that in matters of expenditure the coat must be cut according to the cloth; nevertheless it is a hard and uncomfortable fact that insect pests are not in the least perturbed by any world-wide depression.

Colin Smee,
Entomologist.

Report of the Mycologist for 1930.

The work for the year 1930 has been devoted almost entirely to investigations into the cause of and possible remedial measures for tea yellows. A small amount of experimental work has been done, in a preliminary manner, on the other diseases of tea mentioned below. These diseases will need considerable further investigation.

I should like to thank all those planters in the Mlanje and Cholo districts who have been so generous in their assistance with all the experiments connected with tea which have been carried out this year. The Agricultural Department owns no land in the tea areas, and without so much help from various estates no experimental work would have been possible.

Tea.

Tea Yellows.—Investigations into this disease have been carried out from the start in full collaboration with Dr. H. H. Storey, Plant Pathologist of the East African Agricultural Research Station, Amani. The results of the experimental work are most encouraging. It is hoped that at the end of next year some of the results will be published. At the present time, however, it is considered inadvisable to publish results which have been obtained so far.

The symptoms of the disease were briefly described by Dr. E. J. Butler in his *Report on some diseases of tea and tobacco in Nyasaland* which was published by the Department in 1928. The disease can be recognised in approximately four separate stages, as follows:—(1) The leaves, especially at the apices of the shoots, become chlorotic and mottled, the veins standing out green against the chlorotic intravenous tissues. The leaves retain their normal size. (2) The leaves towards the apices of the shoots become markedly chlorotic and may be reduced to less than one quarter their normal dimensions; the lower leaves on the shoots start to fall; the internodes become progressively shorter as growth continues. (3) Only diminutive chlorotic buds remain at the apices of the shoots, which are thin and whippy; a few dormant buds, in the axils of the leaf scars below, begin to shoot, but they also give rise to small chlorotic shoots. (4) The leafless shoots die back from the apex. The whole bush may appear dead, but a closer examination will often show a few isolated chlorotic buds at the base of the branches.

The disease has been found capable of killing plants within a year of their being transplanted into the field. Normally, however, the progress of the disease (which always shows the four stages described) is slow, especially in the first two stages. A fully developed bush probably takes over two years to be killed. Bushes are often seen to be affected unilaterally, one half of the bush being perfectly healthy while the other half shows any of the four stages of the disease.

A fungus *Rhizoctonia bataticola* has been found associated with the roots of affected plants. It is uncertain what part this fungus plays in connection with the disease.

Dieback.—This disease does not manifest itself until the start of the hot season (middle of September) and continues until the start of the rains (middle of November), when it gradually becomes less in evidence.

Preliminary inoculation experiments have shown that a fungus (*Stilbella* sp.) is capable of causing the dieback. It is not known yet whether any other fungus is connected with the disease. The fungus is closely related to, if not identical with, that described by Petch as *Stilbella Theae* Bernard, which is said to be visible on affected branches "in the form of minute orange red stalks, expanded above into a small head". Experiments show that this fungus is capable of affecting weak bushes in Nyasaland readily while it cannot attack healthy bushes. Further work is necessary to find suitable control measures. At present the only course which can be recommended is to cut off the affected branch six inches below any discoloration in the wood and paint the wound with Stockholm tar to prevent reinfection by spores of the fungus.

The disease is serious enough on some estates to warrant a small gang of boys to be trained and allotted to the task of cutting away affected branches in the months of September, October and November. The fungus travels readily down the branches and, if not checked before it reaches the main stem, can undoubtedly assist in killing fully grown tea bushes in this way.

Bushes affected by tea yellows are those most seriously attacked by *Stilbella*. The disease is probably closely connected with the weak condition of the bushes; further work may prove that improvement in the health of the tea gardens most troubled by dieback will be the most efficient method of control.

Stem and Branch Canker.—The disease, which is most serious in nurseries, is recognised by the swollen cankerous growth of affected parts of the stems and branches. The disease has assumed the name of "Macrophoma Canker" in Nyasaland. The name is unfortunate and should be discouraged, because it becomes confused with a different disease in Ceylon known by that name. The latter disease is definitely associated with *Macrophoma theicola* Petch. Dr. Butler in his 1928 report made no definite assertion that the disease in Nyasaland was caused by a different

species of *Macrophoma*, namely *M. theae* Speschnew. He stated that he found a mycelium of a fungus spreading "throughout all the tissues" and again states "it is less certain that this mycelium is that of *Macrophoma theae*". Inoculations have been carried out this year with the following fungi which have been isolated from the canker in Nyasaland:—*Phoma* (two spp.), *Macrophoma* sp., *Colletotrichum* sp., *Pestalozzia* sp. and *Glomerella* sp. All the inoculations with these fungi failed to produce cankers.

The first stage of the disease can be seen on the young green stems as small elongated patches which have the appearance of bruises. The discoloration is at first only slight, but the bruise gradually darkens in colour until it is purplish-brown. The surface of the bark (cortex) has not been found to be broken in any way in the first stage of the disease. The bruised appearance is caused by the green cortex overlying a necrotic purple patch of tissue (? pericycle or outer phloem). No fungus has been found by microscopic examination of the diseased areas in the first stage, but as soon as the bark splits, due to the initiation of the cankerous gall growth, fungus hyphae have been found penetrating the tissues.

Attempts have been made this year to isolate a fungus or bacteria from the earliest stage of the disease. So far the necrotic tissue (which can be more easily seen by peeling or scraping off the green cortex) has yielded no organism whatever. The disturbance seems to remain entirely local. Observation experiments, over a period of nine months, have shown that the canker does not travel downwards into the root, but fresh cankers can be formed in succession up the stem as the latter grows. The fact that the canker does not travel down the stem points strongly against the view that any active parasitic organism is connected with the disease in the manner originally suspected. It is interesting to note that new branches can be put out by the plant from the middle of badly cankered areas of the stem and that these branches bear healthy foliage.

The dieback, which is sometimes produced by the disease, is not a typical symptom of the disease; indeed, it can be counted as a secondary disease brought about by the canker severely weakening the plant by distorting the conductive tissues, thereby permitting a weak parasitic fungus (*Colletotrichum* sp.) to gain an entry above the canker. Dieback, therefore, is not usually associated with this disease until the strain of the dry season is felt by the cankered plant.

The interference with the conductive tissues causes another secondary effect, namely, the interference with the translocation of starch and other carbohydrates from the leaves to the roots. In the dry season, affected plants can usually be recognised readily by the terminal leaves becoming dully yellow and drooping slightly although remaining turgid. If these leaves are examined in the laboratory they are found to be filled with starch grains at the same time as the healthy leaves are devoid of starch, i.e., in the early morning. This secondary effect is of much greater importance than the dieback (which is inclined to stop at the lowest canker) because it interferes seriously with the storage of starch in the roots, at all seasons of the year, thereby rendering the nursery plant devoid of the maximum food reserves which are so necessary for successful transplanting.

The control measure in the past has been to cut back the stem or branch below the canker. It is thought that this measure was successful, not because it prevented any fungus travelling down into the root, but because the canker was cut out in time to allow the plant to put forth new shoots and to start the manufacture of new root reserves. Cutting back below the cankers is, therefore, still recommended in both field and nursery. A further recommendation is suggested, namely, that planters examine their nurseries carefully for the earliest stages of the disease. If there is evidence of a large percentage of affected plants in the beds, the seedlings should not be allowed to run for a second year in the bed. By this means the cankers can be cut away when the plant is transplanted and before the cankers have had time to develop sufficiently to interfere with the growth aud metabolic functions of the plant.

Considerable further work is necessary on the disease, especially with regard to the actual causal agent and the factors which render the plants susceptible to the disease.

Violet Root Disease.—Dr. Butler mentioned an isolated case of this disease in his 1928 Report. He refers to the causal fungus as a species of *Rhizoctonia*, possibly the sterile stage of *Helicobasidium longisporum*. The disease has been found this year to be fairly common in small areas in tea nurseries. It becomes evident in the dry season. Plants may either wilt and die suddenly or else they may show signs of being affected by drought before the adjacent healthy plants. Over 1,000 eighteen-month-old plants were observed to have been killed by this fungus in one nursery during the course of three months. The disease is inclined to occur in patches. It probably originates from dead forest tree roots left in the ground when the nursery site is cleared. One case seemed to show this clearly, as the disease was found to run as a narrow band in a straight diagonal line through four nursery beds.

The disease symptoms can be confirmed by lifting suspected plants. The soil is found to adhere to the root far more than in healthy plants. If the soil is knocked off, the root is found to be covered with a violet weft of fungus mycelium, the colour varying in intensity according to the length of time the fungus has been established on the root. On closer examination minute black dots ("infection cushions") and narrow brown creeping strands of the fungus can be seen as well. This fungus causes a dry root rot.

So far it has only been found in the field on young tea. Whether this fungus can attack old tea is not known here. There would seem, however, to be a risk of planting out any seedling in the field likely to spread the fungus through the soil from plant to plant. Healthy looking plants, close to affected ones, can often be found to have the fungus on their roots. Care should be taken,

as far as possible, not to plant out apparently healthy plants which have been growing within two or three feet of diseased ones. Isolation of diseased patches by trenching is also recommended. No definite success was attained by treating the soil with Jeyes fluid as recommended in Ceylon.

Coffee.

Leaf Rust.—Until this year Nyasaland was regarded as being free from the presence of leaf rust (*Hemileia vastatrix*). The country can no longer enjoy this distinction, and it has been found on close enquiry that the disease has been present in the past, although it was not reported to the Department.

A severe case of this disease was found affecting a small acreage of an imported variety of coffee (*liberica-arabica* cross). The fact that *Hemileia vastatrix* had not been reported before was probably due to the fact that the *arabica* strain of coffee, which had been the foundation of the Nyasaland coffee industry, proved itself to be nearly immune to this disease. This was perhaps due to the fact that either (a) it originated from an original endemic stock of coffee or (b) it was originally an exotic stock which quickly became acclimatized.

Coffee planters in Nyasaland must now realise that their coffee is not entirely safe from possible ravages of leaf rust. The disease, however, is now considered to be one of many which indicate that the affected plant is growing under unsuitable conditions of environment. The planter should not rely on spraying as a control measure for this disease unless he has satisfied himself that he is unable to ameliorate the environment in which his coffee is growing. It is essential, therefore, that every step should be taken to avoid allowing the coffee plants to become weak, otherwise they immediately expose themselves to attack by leaf rust.

No experimental work on coffee diseases has been done in Nyasaland, but the following points are worthy of consideration in attempting to avoid harm from leaf rust in the country:—

(1) Check overbearing (largely related to unsuitable shade conditions).

(2) Conservation of soil fertility and humus content of the soil: suppression of harmful weed growth.

(3) Careful choice and planning of windbreaks, especially against hot winds.

The following description of symptoms of coffee leaf rust is given below in brief because the disease is not familiar to many growers in the country. The disease is confined to the leaves. At first minute yellow spots appear on the under surface. These spots enlarge and become covered with an orange powder (fungus spores) which can be easily rubbed off by hand. No powder is found on the upper surface, but bright-brown spots are found in positions corresponding to the areas affected on the lower surface. In severe cases of attack, the leaves are shed readily and the plant may be completely defoliated. The shedding of a succession of new flushes of leaves in the place of fallen ones can put such a strain on the plant that the latter is eventually killed. The disease is naturally inclined to cause light berries.

Black Tip.—An estate in the Mlanje district became badly affected by an abnormal growth of the coffee plants during the dry season. The symptoms were very similar to those given for the disease known by this name in Kenya. The affected coffee was young (approximately seven months from the date of transplanting).

The young terminal buds of the stem and branches became badly scorched, shrivelled and turned black. The leaves were badly scorched at the margins which became irregular, while the blades were wrinkled, chlorotic and mottled. Death of the terminal buds stimulated the growth of normally dormant axillary buds to form secondary branches which became similarly affected to the rest of the plant. In this case, there seemed little doubt that the coffee suffered severely from lack of protection from hot winds.

Olives.

Root Disease.—A small plantation of olives, which were just coming into bearing, was found to be badly attacked by *Armillaria* causing a wet rot of the roots and cracking of the stem at the collar. The land had not been stumped previous to the planting out of the olives. Control measures were recommended on the lines of stumping and trenching to try to isolate the disease. It is not known whether any other fungus was present before or with the *Armillaria*.

R. Leach,
Mycologist.

Annexure F

Report on the Work of the Cotton Experiment Stations, Season 1929-30.*

INTRODUCTION.

Staff.—Mr. Lochrie returned from leave in November, 1929. After assisting with the planting at Makwapala he proceeded to Port Herald to superintend the laying out of plots and planting up of the latter station. On his return to Zomba he had the misfortune to suffer a serious breakdown in health which led eventually to his transfer to Swaziland in July, 1930. Mr. Miller was in charge of the Makwapala station up to the time of his departure on leave in May, when the routine duties of his post were undertaken by Mr. Lochrie during his convalescence.

The routine duties of the Port Herald Station were done by Mr. Lawrence, now District Agricultural Officer, Lower Shire, who was in charge of this station during the whole season. Charge of the new Station at Domira Bay on the west shore of Lake Nyasa was undertaken by the author who has to thank Mr. T. R. Walkington, of the Chitala Estate, Domira Bay, for his most kind assistance with this station. In addition, the author was also in charge of the Makwapala Station from the time of Mr. Lochrie's departure on transfer.

Summary.

It is pleasing to be able to report a most successful season, in which a new record has been established for cotton production in Nyasaland.

Substantial increases in yield have been reported from nearly all districts, especially from the Lower Shire areas, and the total crop for 1929-30 is expected to exceed last season's total of some 6,000 bales by not less than 50 per cent. of that total.

Planting date propaganda, based on the results of experiments at the Port Herald Station and on Mr. J. Dickie's estates at Maperera, has it is hoped had a considerable share in promoting the increase on the Lower Shire, while the success of the Over-the-Top strain produced by Makwapala has had much to do with the increase in up-country areas.

The promise shown last year by U4 has been fully substantiated by the results obtained with the strain this season, and it seems very probable that it will prove as much in advance of Over-the-Top as the latter was of Nyasaland Upland in areas other than the Lower Shire. In the Chikwawa and Lower Shire areas, however, it will be very difficult to decide on the relative merits of U4 and of Cambodia, and the latter may yet prove more suited to the needs of the cotton growers, especially if attempts to produce a satisfactorily shaped plant succeed. As has been reported previously the tendency of Cambodia is to produce rather an untidy plant affording good cover to pests.

As foreshadowed last season, work at Makwapala has been concentrated on attempts to ameliorate the unsatisfactory soil conditions at this station. Results to date are very promising, and though it is thought unlikely that this station will again be of use as a cotton selection and breeding centre it may prove most valuable as a general station for study of the special problems of laterised soils.

Work at Port Herald was concentrated on the U4 and Cambodia strains reported on last year, and the unsatisfactory rainfall distribution at this station gave the surviving strains a most severe test.

The opening of the new Domira Bay Station has provided conditions which approximate closely to the mean of the country, and it appears highly probable that at this station cottons can be bred to suit both winter and summer cropping conditions. The soil is a deep alluvium and is free from the laterised pan which afflicts Makwapala.

It possesses also an advantage over Port Herald in that jassid can be expected to attack the crop every season so that the danger of a jassid-susceptible strain providing a deceptive success is thus minimised, and the mistake into which the behaviour of Foster-Whitehall G at Port Herald led us in 1926-27 is not likely to be repeated. The Domira Bay Station will allow of summer and semi-summer cropping being done and there is the great additional advantage that flood areas exist in its near vicinity which allow of winter cropping on Port Herald lines.

MAKWAPALA EXPERIMENT STATION, REPORT FOR THE SEASON 1929-30.

Season.—Apart from a slightly higher December rainfall in the former year there is a great similarity between this past season and 1926-27 when the record yield of cotton a Makwapala was made.

The rains broke early, were well distributed, and never excessive in amount and the result has been good returns from every crop grown on the Station.

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The rains ceased rather abruptly on April 25th and thereafter the weather was in general dry and warm up to the cotton uprooting in July.

Minimum temperatures commenced to drop below 60°F. on May 8th, two days earlier than in 1929.

General.—As foreshadowed in the report of last year, work at this Station has been concentrated on the special soil problems provided by the laterisation process which has taken place

Further progrees has been made in improving the ridge terraces, which now need very little to be done to them beyond being widened. Dry season operations have been directed towards this end. Soil erosion and its problems appear to have been dealt with satisfactorily by the measures adopted. The main problem now is to improve the soil on the station by means within reach of the general cultivator.

As has been reported previously, implements have been obtained and methods for their usage devised, which promise to do much by the aid of better tillage. The deeper ploughing achieved last season certainly seems to have made an improvement in the general tilth.

The crusting which is typical of laterised soils was definitely less on the land supplied with farm-yard manure last season and every effort is being made to increase supplies of this manure.

Two pole and thatch covered yards for cattle have been erected at small cost, eight new working bullocks purchased, and seventeen head of cattle obtained on loan from the Veterinary Department. Two bullocks died during the year, and the stock on the station now amounts to approximately one beast to two acres in cultivation.

The cropping of the station has been revised to allow of at least a third of the total acreage being planted to rooting legumimous crops, and some interesting comparisons have been made between certain of these crops regarding their effect on the tilth.

The method of pot-planting tree seedlings reported last season proved highly successful and excellent results were obtained with the Eucalyptus planted out. The Callitris were however a failure due apparently to the seedlings being too small at the time they were set out. The attempt to establish plantings of these is being repeated this season with nurseries sown three months earlier. Arrangements have been made with the Forestry Department whereby an experimental forestry plantation of some six acres is being established along the eastern boundary of the station. The scheme has been assisted greatly by the Blantyre and East Africa Co., Ltd. loaning the land free of charge. The expenses of establishing this plantation are being borne by the Forestry Department, and the work is being done by Makwapala labour under their supervision.

Valuable information bearing on the soil problems at Makwapala with special reference to the problems of shifting native cultivation on similar soils is likely to be afforded by this plantation, especially by the section devoted to the regeneration, natural and otherwise, of native trees.

The method of pot-planting seedlings promises also to be of value in obtaining the maximum results from select strains of cotton of which only a few seeds are available, and experiments will be carried out at a future date to compare this method with others which have been tried.

Rotations.—The cropping scheme for the season was as follows :--

	Field		Field		Field	
Rotation I	... Cotton	1 ...	Maize	10 ...	½ Sunn hemp ½ Jack bean	9
,, II	... Cotton	2 ...	Maize	11 ...	Groundnuts	8
,, III	... Cotton	3 ...	Tobacco	12 ...	Pigeon pea	7
,, IV.	Abandoned and used as miscellaneous cropping area.					

In accordance with the revision of the cropping to allow of a greater proportion of pulse crops certain changes were made.

Fields 1, 9, 10 have now been included in a cotton-pulse-cereal rotation, as it has been found necessary to abandon the simple two course cotton-cereal rotations owing to the loss of tilth resulting from it. Field 9, formerly used for general miscellaneous crops, and later a two course cotton-pulse rotation, was sown half to sunnhemp for green manure and half to a deep rooting pulse, the jack bean, (Canavalia sp.) for comparison of their relative effects on the soil conditions.

Fields 2, 11, and 8 have now been placed under a cotton-tobacco-maize rotation and the effect of organic manuring under this rotation is the main object of investigations. Farm-yard manure will be used on the maize break.

Fields 3, 11, and 7 have been placed under a cotton-tobacco-pulse rotation for special study of the effects of pigeon pea on the soil.

Fields 4, 5 and 6 are included in a miscellaneous cropping area until such time as any further addition to the rotation range becomes advisable.

The most interesting result observed this season in the rotation cropping was the difference in effect of the two main deep-rooting pulses on the soil. Land which had been under pigeon pea, half the area annual and half biennial, was cleared and ploughed at the same time as land which had been cropped to jack beans (Canavalia). Both areas were ploughed in mid-September, five months after any effective rainfall had occurred, and investigations showed that there was little to choose between the penetrating powers of either crop. The roots of both had reached up to 66 inches below ground level.

The land which had been under pigeon pea, even for one season only, ploughed up far better than that under Canavalia, and interesting confirmation of this observation was obtained on the Chimpeni Estate (Mr. G. V. Thorneycroft) some four miles from Makwapala, where the same effect was noted. It would appear that the roots of the pigeon pea, in addition to increasing permeability, have some special effect on the surface soil.

The tobacco plots again did well and further confirmation of the good results of planting tobacco after cotton was thus obtained. The plots sown this year consisted of a range of Western Dark Nyasa strains grown on behalf of the Agricultural Department. From them have been obtained some promising progeny blocks which are to be planted this coming season. This Western tobacco and cotton form the most important money crops of the native and study of their relationships agriculturally is likely to yield valuable results.

The land in Field 9, green manured with sunnhemp, has been prepared for maize this coming season and has a good tilth, but the rotting of the green manure is unsatisfactory in spite of its being ploughed under at an early date. Whether green manuring is a sound practice under Makwapala conditions must remain a matter of doubt for some time yet.

Field Experiments.

The decision was taken this season to concentrate on U4, as the main variety of cotton grown at Makwapala. Up to now there has been no significance in the time of planting at Makwapala other than sowing with the earliest planting rain for the best results. It was decided, therefore, to confine field experiments this season to the straightforward problem of spacing.

Four extreme spacings were chosen and sown in a six times replicated randomised block layout. Sowing was done on December 21st and satisfactory stands obtained. Thinning to the required spacings was done on January 17th. Continuous records were kept throughout on fruiting, pest infestation, and growth. Apart from partial suppression of plants at the closer spacings, there were no obvious differences in growth and appearance throughout. Table 1 gives the results obtained :—

TABLE I.

	Spacing.	Mean yield per plot (1/40th acre).	Plants per acre by counts.
A ... 4 x 3	single plant	... 19.53 lbs.	... 3,400
B ... 4 x 3	unthinned	... 22.26 ,,	... 9,000
C ... 4 x 2	single plant	... 20.52 ,,	... 5,000
D ... 4 x 1	,, ,,	... 23.94 ,,	... 9,500

ANALYSIS OF RESULTS.

	Degrees of freedom	Sum of squares	Variance	S.D.
Between spacings	... 3	... 65.3	... 21.8	.. —
Within spacings	... 20	... 248.8	... 12.4	... —
Between blocks	... 5	... 57.8	... 11.6	... —
Random ...	... 15	... 191.0	... 12.75	... 3.57

S. E. of difference between two means=2.1 lbs.

From Fisher's table of "t" it will be seen that a difference of 4.5 lbs. between the mean yields is probably significant.

As will be seen the two densest spacings gave a higher total yield. The density of plants per acre is practically the same in the 4' x 3' unthinned and the 4' x 1' spacing This was ascertained by counts as well as by calculation. There is a slight superiority, not statistically significant, in favour of the better distribution of the 4' x 1'.

The wide spaced 4' x 3' single plant spacing is not statistically inferior to the 4' x 1' spacing.

As far as can be seen there is a progressive increase in yield with the increase in plant density, irrespective of the arrangement.

The two denser spacings gave an earlier and heavier first picking than did the wider spacings, and much of their superiority is due to this.

There was no significant difference between the proportions of stained cotton from each series of plots, the percentage of clean white seed cotton being approximately 88 for each of the series.

Density of plants does not appear to have been the deciding factor in the amount of stainer attack. This affords interesting confirmation of the impression formed from results at Port Herald that, next to environment, variety is the most important factor affecting stainer disease and its incidence.

Cotton Breeding Work.

This was confined to the growing, in progeny blocks, of the single plant selections made from the U4, sown in Field 9 last season.

The whole series suffered very badly from poor soil conditions, more especially the crusting of the soil at sowing time, and germination was in consequence unsatisfactory. Field 1 in which they were sown has been used in the cotton-cereal rotation now abandoned.

Each single plant selection was harvested as a small selfed bulk for trial at Domira Bay this coming season.

It has been decided to discontinue cotton breeding work at Makwapala for the present.

Bulk Sowings.—U4. was sown, the balance of Field 1, Field 2 and 3 being planted to this variety. The Field 1 sowing consisted of a selfed bulk from Gatooma, once grown and selfed at Port Herald, and will provide the future bulk stock of U4 seed at Makwapala.

Fields 2 and 3 were sown with ordinary unselfed bulk U.4 and were used as observation blocks for two methods of cultivation connected with the ridge terraces. In Field 2 the ridges were run downhill towards the terraces so as to permit of better surface drainage than in Field 3, where the cotton ridges were laid up parallel to the terraces on the contour. Growth in Field 2 was more even than that in Field 3, but there proved to be no difference in their final yields.

The whole U4 bulk on Makwapala provided the very satisfactory return of approximately 197 lbs. lint per acre, an interesting figure to contrast with the 192 lbs. seed cotton per acre provided last year by Over-the-Top.

It is pleasing to report that several test-distribution plots in the near neighbourhood of Makwapala gave similar yields to the station bulk.

Soil Survey.

The most important piece of work done this season at Makwapala has been a complete survey of the soil types, and depths to the laterised pan have been recorded throughout the station.

This work took up a great deal of Mr. Miller's time, but will prove a very useful base on which to calculate when we come to assess the improvement that it is found possible to make in the Makwapala soil conditions.

Inspection pits were dug at intervals of fifty yards throughout the cultivation area of the station and a map prepared showing their positions.

Depths to the first signs of laterite were taken in every pit, or to a maximum of two feet if laterite nodules were not found at a shallower depth.

The collated figures for the twelve fields are of interest:—

Field	Average depth to level of laterite inches
1	20.83
2	18.75
3	18.08
4	In excess of 2 feet
5	16.75
6	17.54
7	18.83
8	17.10
9	19.08
10	19.60
11	15.90
12	20.80

Only one field has a soil depth to the laterite pan in excess of 24 inches and only three fields exceed 20 inches in soil depth. It can hardly be wondered at that cotton behaves as a shallow rooted crop and suffers severely from drought as soon as the rains cease. It is an interesting reflection that the one field with soil deeper than two feet is the only part of the Makwapala area which had been cleared by natives in the past.

Representative root systems of the various crops on the station were dissected out from the soil surrounding them by the aid of a powerful water jet. Of these cotton, pigeon pea, jack bean (Canavalia) and sunnhemp roots were of most interest. In only one case did the tap root of a cotton plant penetrate more than 16 inches unhindered; in that case an ultimate depth of 32 inches was reached. In one instance the tap root split at the laterite layer and one branch of the root system reached 32 inches. In no other case examined did a tap root penetrate more than 16 inches.

The maximum depth reached by sunnhemp, a supposedly deep rooting legume, was 30 inches.

Its behaviour was much on a par with that of the cotton.

It was found however that neither Canavalia nor pigeon pea roots found any apparent difficulty in coping with the pan. In both crops it was found that the main root system had been able to penetrate and reach below the pan, even where the induration was such as to need the help of a pick and crowbar to excavate the root system.

It is in these two crops that our chief hope lies of ameliorating the bad soil conditions of Makwapala by the agency of plant roots, and, as has been said above, they will play an important part in the rotation practice of the farm.

Insect Pests.

Bollworm was present throughout the season but as in 1927 was never able to increase sufficiently in numbers to do any real damage.

The largest source of loss this season was from other causes and of these stainer-borne disease was the most important.

An attempt was made to trap stainers, as they invaded the cotton, on the lines adopted at Gatooma. The first invaders were found in mid-February, and a series of seed traps were laid down throughout the entire cotton acreage. Two double handfuls of seed were placed in a shaded depression and formed the trap. Daily examinations of all traps were made from March 1st when all stainers found feeding on the cotton seed were caught and destroyed.

About the first week in April the traps began to be of little use in checking the spread of the stainers in the cotton and hand picking in the field was started. In spite of this, and of the destruction of large numbers of broods, it proved impossible to cope with the invasion and in mid June stainers were present in numbers and breeding freely.

The total destruction of stainers amounted to something in excess of 50,000 and so far as could be judged from the ultimate number present was useless.

A more hopeful line than the destruction of the stainer at Makwapala would seem to be some study of the relationship between the disease it carries and the environment. It would appear possible that the conditions which militate against the effectiveness of the stainer as a carrier are more important than the mere presence of the insect.

The low-lying areas to the east and south of Makwapala contain many host plants of the various stainers. While these exist as a source of practically unlimited numbers of stainers there does not appear much hope that any attack direct will deal with the pests.

An indirect means of avoiding the damage done would seem more promising and in this connection it is of interest to report that there is possibility of U4 allowing a modification in the planting date used at Makwapala.

Quite by chance a small plot of this strain was sown at Mr. Thorneycroft's Tengerangiru Estate rather late in January, and, instead of proving the failure which previous experience with Over-the-Top and other varieties would have lead us to expect, the plot gave a good yield of remarkably clean lint, in spite of being late and strongly infested with stainers. A time-of-planting experiment is accordingly being arranged at Makwapala with U4 this coming season.

DOMIRA BAY EXPERIMENT STATION, REPORT FOR THE SEASON 1929/30.

General.—Permission to open this station was received from the Corporation early in 1929. Clearing was commenced in good time and 30 acres of land prepared for planting. It was found, however, impossible to stump the land prior to planting and it was decided to confine the cropping for 1929/30 to bulk observation plots of the three most succesful cottons so far tried in the up-country areas.

No buildings other than temporary grass huts were erected in 1929. In the 1930 estimates however provision was made for the erection of two farm buildings and a dwelling house, the latterto be paid for by Government, the former by the Corporation.

Owing to the difficulties arising from Mr. Lochrie's illness and transfer it was found impossible to complete the dwelling house in 1930 and building work this dry season has been confined to the erection of the two stores and the house foundations. The balance of the money needed to complete the house has been carried forward to 1931.

The two stores, now nearly completed, comprise in addition to storage space, a capitao's office and tools store and a farm office for use of the European in charge. They are well built in burnt brick.

Mr. Walkington, manager of the neighbouring Chitala Estate, has kindly offered the guest-house on his estate for our use during the coming rains.

A further 30 acres has been cleared for this coming season and the station now straddles the new main road from Dowa to Domira Bay. Its site from a propaganda point of view has much to recommend it.

The soil is an alluvial clay loam overlying elluvial soil derived from highly decomposed schists. It is highly permeable to rain water and the levelness of the site chosen should render soilerosion of little moment. Ridge terraces on the lines of Makwapala will, however, be adopted from the point of view of water conservation. It will be possible to make them at the maximum spacing, so that they should offer little difficulty to the arrangement of plots.

A certain amount of stumping has been done on the land cleared in 1929 and the whole area will again be planted to cotton in 1930/31.

It is hoped to arrange a variety, time-of-planting and spacing trial, and to plant observation blocks of a very large range of cottons, particularly of U4 and Cambodia sub-strains.

The Corporation wish to record their great indebtedness to Mr. T. R. Walkington, who has kindly seen to the entire routine work of the station since its inception, and to Mr. H. M. Mitchell of the P. W. D. who has supervised the building construction. Without the generous help of these two gentlemen it would have proved very difficult to get the station in good shape for the coming season.

The area in which the station is situated is supplied with two rivers which only flow in, and just after, the rains. At other times the only water supply is obtained by digging in the sandy river bed.

An early attempt was accordingly made to obtain water from dug wells and it is pleasing to be able to report that the second of two attempts made has proved completely successful. The first well, sunk near the house site, is not however to be abandoned but will be persisted with next season. It is now down some 38 feet, and is floored with decomposed rock. The writer is advised by the Government Geologist, Mr. F. Dixey, that water may reasonably be expected at about 70 feet and that the supply should be adequate. He has also indicated another site not far from the house where an attempt to dig a well might be made.

A chain survey has been made of the cleared area and the station has been laid out in 5 acre blocks. These measuring 220 x 110 yards have been arranged as nearly as possible with their long sides parallel to the contours, and therefore to the main road, which runs along the ridge line in an east and west direction.

The site of the station at approximately the centre point of the country should, with its attractive agricultural attributes, make it an excellent headquarters for cotton breeding work. It is easy of access to the western plateaux areas of Angoniland, is within 14 miles of a good lake port, and hence will be easily reached from any part of the Southern Province when the railway extension to Lake Nyasa becomes an accomplished fact. At present it is connected with other areas by a quite good all-weather road, and may be reached from Zomba in a day by motor car.

The soil of the new station while not the best in the Domira Bay area is a very fair average, and is entirely free from the unpleasant pan experienced at Makwapala.

It will be possible to grow summer crops on the station itself and winter crops on flooded areas within easy reach. The Nkhombedza dimba, a large fertile area some 4 miles from the station on one of the roads to Lake Nyasa, affords cropping conditions exceedingly like those of Port Herald, in spite of the Domira Bay area being some 1,500 feet higher in elevation than is Port Herald. The difference in latitude and the proximity to the lake doubtless has much effect in minimising the difference in elevation.

Another feature of Domira Bay is its freedom from the mist-belt conditions which frequently afflict Makwapala and do so much damage to the cotton—they have done so in five years out of seven to date.

It is hoped that future work will show its suitability as a breeding centre for both winter and summer crop cottons, in which event its position at one end of a small isolated cotton-growing area should make it an admirable seed bulking centre. This area is isolated by strips of waterless country immediately to the north of the Lipimbi river and the south of the Chitala river, between which streams the new station is situated.

Rotations.—The natives of Domira Bay have a very poor collection of food crops compared with those of other parts of the country and especially with those of the Lower Shire. Bulrush millet (*Pennisetum typhoideum*), a very useful cereal, is for example practically unknown, and the pigeon pea (*Cajanus indicus*) appears to be absent altogether. Both should do well. There is little doubt that in addition to affording information of direct use to cotton-growing, a set of suitable rotations of cotton and native food crops will be of considerable value. It is intended to start this work in 1931/32 when the station is well established.

Cotton.—The area cleared in 1929 was planted with 10 acres each of U4., Cambodia, and Over-the-Top (selection B-30-1).

The writer proceeded to Domira Bay on December 10th. Rains favourable to planting fell on December 15th and following days, and the whole area was planted by the 19th. Excellent germination was obtained with both U4 and Cambodia (strain G.C. 664/1 ex Port Herald) but the stand obtained with the Over-the-Top was not so good.

Counts of the stands obtained gave the following results on January 25th. Sowing had been done by hand in holes with a spacing 3′6″ x 1′6″.

U4 78.5 per cent., Cambodia 73.3 per cent., Over-the-Top 45.5 per cent. The poorer stand of the Over-the-Top was due to the stainer damage done at Makwapala in 1928/29. The Cambodia and U4 seed were from Port Herald where stainer was conspicuous by its absence in that year.

Growth was good throughout for the new ground conditions, and cropping excellent, in spite of a five weeks' drought in February/March.

Picking commenced on May 28th and was finished on August 8th.

The approximate yields were as follows:—

U4 546 lbs. seed cotton per acre.
Cambodia 560 „ „ „ „ „
Over-the-Top 441 „ „ „ „ „

For the new ground conditions these results can be considered very good and compare favourably with a yield of 593 lbs. of seed cotton per acre of U4 obtained on Mr. Walkington's plot on the Chitala Estate on five year old land.

Insect Pests.—What might be described as the normal Nyasaland succession of pests appeared on the cottons and is rather well brought out by the pest observations given in Table II. These observations were made by the capitao in charge of the stations who had formerly acted as recording boy at Makwapala.

Jassid became evident early in the season and was most obvious on the U4, the leaves of which were well reddened by April. In spite of this, the strain did not appear to be much affected, and its final yield was good.

Of the bollworms, Diparopsis was most abundant throughout the season, but the usual end of the rains wave of Chloridea appeared also. The latter at Makwapala has been shown to be a decisive factor in the degree of bollworm damage. Analysis of sheddings showed the falling off of bollworm attack towards the onset of the dry weather and, to a less marked degree, the increase in non-bollworm loss.

Stainers, though always present in large numbers, were responsible for exceedingly little damage. The dry spell in February/March was no doubt a factor in this.

TABLE. II.

Jassid Counts. Nymphs Weekly Per 50 Leaves.

Mean per leaf.

Date.	U.4 Field 4.	U.4 Field 5.	B-30-1 Field 3.	B-30-1 Field 6.	G.C. 664/1 Field 1.	G.C. 664/1 Field 2.
13/2/30	2.10	0.18	0.06	0.52	0.56	0.56
20/2/30	0.80	0.01	0.18	0.02	0.10	0.48
27/2/30	0.10	0.22	0.01	—	0.40	0.54
6/3/30	0.86	0.32	0.32	0.04	—	0.18
13/3/30	1.24	0.03	0.32	0.04	0.14	—
20/3/30	1.10	0.52	0.36	0.02	0.16	0.28
27/3/30	1.76	0.52	0.36	—	0.46	0.74
3/4/30	0.86	0.06	0.32	0.04	0.40	0.16
10/4/30	0.56	0.38	0.08	—	0.20	0.26

Bollworm Counts. Weekly Per 100 Plants.

Date.	Diparopsis.	Earias.	Chloridea	Misc. Leaf Eaters.
22/2/30	7	7	6	37
1/3/30	18	2	—	50
8/3/30	61	—	—	59
15/3/30	111	5	5	2
22/3/30	88	—	15	14
29/3/30	71	—	1	50
5/4/30	47	—	45	2
12/4/30	42	1	34	40

Sheddings from Sample Row in Field 1. Weekly Analysis.

Date.	Buds.		Flowers and Bolls.	
	Bollworm	Non-Bollworm	Bollworm	Non-Bollworm
21/2/30	86	1	10	3
1/3/30	10	5	57	38
8/3/30	4	—	50	46
15/3/30	4	1	74	21
22/3/30	8	1	81	9
29/3/30	20	3	43	34
5/4/30	15	17	50	18
12/4/30	19	—	29	50

It is unfortunate that after the second week in April the capitao was unable to spare time to continue these observations. The dry season work then commenced and his time was fully occupied with the brickmaking, clearing and other matters.

Flood-land Cotton.—A plot of cotton sown on April 12th in a piece of "Dimba" land near the Station proved a failure. Germination was patchy and growth poor. The plot, which consisted of 1/8th acre U4 and 1/8th acre Cambodia, was apparently sown too late for the season. It was

chosen by the capitao, a stranger to the area, and apparently was poor in subsoil water content. Judging from a number of native-grown plots which were kept under observation, considerable local knowledge is necessary in the matter of choosing dimba gardens for cotton.

PORT HERALD STATION, REPORT FOR SEASON 1929/30.

Season.—This has been a drought year at Port Herald, though, fortunately for the native cotton, the rains elsewhere on the Lower Shire were rather better distributed. Tengani's area, some fifteen miles to the north of the Station, for example, received planting rains in February which missed Port Herald entirely.

The late rains were fair and would have been ample for the cotton at the Station, had the subsoil water content been better built up by the main rains. As it was the lateness of the planting rains and their small amount proved a handicap which the Station cotton was unable to surmount.

General.—It was decided to increase the cotton area of the Station to 30 acres. For this purpose the two-course rotation adhered to hitherto was temporarily abandoned, and the whole Station put under a cover crop of sunnhemp during the early rains. This sunnhemp it had been intended to plough under in early January in good time before the cotton was to be sown. The dry spell in January-February, however, made it necessary to burn much of the cover crop instead of allowing it to rot or be devoured by termites. The effect of the cover crop cannot therefore be assessed from the point of view of its value as manure.

The whole area was planted to cotton when the rains at last permitted sowing, most of the bulk cotton being planted in the first fortnight of March.

To provide for a future 30 acres of cotton a further 20 acres have been added to the Station, making the total cultivation area 50 acres, and in addition 10 acres of flood land on the Ndinde Marsh area just south of Port Herald is being marked off as an experimental plot. This will allow the resuts obtained on the dry land area of the present Station to be checked for Dimba conditions.

Considerable progress has been made with the co-operative seed multiplication scheme referred to in last season's report. Upwards of 500 growers have been registered and arrangements are being made for a trial bulking during this coming season of *U4* supplied by the Station. *U4* has been chosen in preference to Cambodia, in spite of the latter's superiority this season, on account of the wider range of conditions to which it has shown itself to be suitable.

Whether Cambodia may yet prove more suited to use on the Lower Shire remains to be seen

Field Experiments.

The variety trial last season indicated that two strains—*U4* and Cambodia G. C. 664/1—were so markedly superior to all else that the work of the Station should be concentrated on them. This season's work has given us no reason to change this opinion.

It was decided to repeat the comparison of these two strains using Nyasaland Upland as standard, and to combine the variety trial in one set of experiments with a time-of-planting trial, and in another with a series of spacing experiments.

Each variety at each spacing and time of planting was sown in 1/40th acre, 5 row plots replicated six times. One set of randomised blocks was used for the time of planting experiment, another for the spacing experiment.

The results given below are obtained on the first two pickings only in order to produce some results in time for inclusion in this report. There is no reason to suppose that the final pickings will modify the result to any appreciable degree.

Spacing Experiment.—Sowing was done in holes on March 5th under good conditions, and excellent germination needing but little supplying was obtained. Apart from drought which gave rise in June/July to a certain amount of defoliation, growth was healthy throughout. Regeneration was not marked as in the previous season, and late pickings are not likely to be large. The yield this season at Port Herald Station amounts to about half what is considered now to be a normal crop.

Pickings were taken on September 13th and again on October 6/7th with the results given in Table III.

TABLE III.

Mean Yield per Plot. Spacing and Variety Experiment.

Cambodia	125	lbs. seed cotton.	
U.4 ...	10.7	„ „ „	
Nyasaland	9.4	„ „ „	Standard error of difference between two means = 1.3 lbs.
4′ × 2′ unthinned	13.5	lbs. seed cotton.	
4′ × 2′ two plants	7.6	„ „ „	
4′ × 1½′ one plant	9.3	„ „ „	Standard error of difference
4′ × 1′ „ „	13.6	„ „ „	between two means = 1.9 lbs.
4′ × ½′ „ „	10.3	„ „ „	

It will be seen that the relative positions of U.4 and Cambodia have been changed and that the latter, as last season, is definitely superior to Nyasaland Upland. U.4, though higher in yield than Upland, is not significantly superior to the latter. On the other hand there is no significant difference between U.4 and Cambodia. Repetition of the experiment would seem advisable, and it is intended to do this with one of the substrains derived from the Cambodia which may show a better plant type than its parent. The straggling habit of G. C. 664 is against its adoption at present. A wet year would almost certainly mean its failure from stainer damage.

The results of the spacing experiment would indicate that yield is in large measure proportionate to plant density. The discrepancy shown by the 4′ ×.½′ spacing might be explained by the lack of symmetry of this arrangement. It is highly probable that Port Herald might with advantage use a 3′ spacing between rows with a moderate distance between holes. In this connection it may be observed that the natives' favourite spacing of about 3′ × 3′ with 5 to 7 plants per hole may not be far from the optimum.

Time-of-Planting Experiment.—Lack of planting rains in February confined the range of times of planting to March. No extension was made into April on account of previous results recorded, which indicate a definite disadvantage in sowing as late as this on land not subject to flood.

Sowings were made on the 4th, 11th and 18th March, and fair germination obtained; growth was good, and far more even than has been experienced hitherto. Table IV gives the results obtained.

TABLE IV.

MEAN YIELD PER PLOT. TIME OF PLANTING AND VARIETY EXPERIMENT.

Cambodia	13.2	lbs. seed cotton.			
*U.*4	12.2	„	„	„	Standard error of difference.
Nyasaland	10.7	„	„	„	between two means = 0.90 lbs.
March 4th sowing		13.1	lbs. seed cotton		
„ 11th „		12.9	„	„	„ Standard error of difference
„ 18th „		10.1	„	„	„ between two means = 0.90

The earliest sowing date is the best and the latest the worst, and the results provide an excellent confirmation of views expressed previously on the subject of sowing dates. So far as dry land cotton is concerned the Lower Shire native should be encouraged to plant not later than mid-March.

The variety trial in this experiment is an excellent confirmation of the results obtained in the spacing experiment and the same remarks apply. Cambodia was undoubtedly superior in drought resistance to U.4. Continuous records were as usual kept on the two sets of experiments.

COTTON BREEDING WORK.

Bulk Sowings.—The Station's bulk cotton this year was U.4. In addition to the bulk from the Port Herald crops of 1929, Mr. Peat of Gatooma Cotton Breeding Station, Southern Rhodesia, kindly supplied enough of his ordinary mixed bulk for some 3 acres. This was obtained in order to increase the available selection range of the Port Herald U.4.

A total of 20 acres of bulk U.4 was planted on the Station, and a spacing of 4′ x 1½′ leaving four plants per hole adopted as standard. The results of the spacing experiment indicated that this is not far from optimum, but probably suffers from lack of symmetry. A spacing of 3′ x 2¼′ might be an improvement.

Picking is still proceeding (October, 1930) and an average crop of some 350 lbs. clean white seed cotton per acre is in prospect. This yield, while not so good as we hoped to obtain from the appearance of the cottons earlier in the season, is probably as much as could be expected from the amount and distribution of the rainfall received.

Three small bulks from selections made by Mr. Lochrie in 1928 were sown in fields 7 and 10 These were made under rather extreme jassid conditions and are distinctly promising. Table V gives their general characters as compared with the Gatooma mixed bulk grown side by side with them.

TABLE V.

STRAIN	HALO LINT LENGTH	GINNING %	WT. 100 SEED.
Gatooma Bulk ...	... 27.8 mm.	... 35.4	... 10.8 gms.
P. U. 4/5-1 ...	... 29.3 mm.	... 35.2	... 9.65 gms.
P. U. 4/5-5 ...	... 27.7 mm.	... 36.8	... 10.35 gms.
P. U. 4/5-12 ...	... 29.5 mm.	... 35.7	... 10.95 gms.

The lint length and seed weights have been maintained in an admirable fashion under the drought conditions experienced.

The three substrains will be bulked this coming season on 2½-acre blocks and compared in a strain test for yielding power.

Progeny rows and small bulks.—A large range of progeny rows of U. 4 and Cambodia selections were grown in fields 7 and 10, and promise to provide a useful range on which to work. They have been augmented by a number of Cambodia strains kindly supplied by Mr. Peat, which promise to enlarge the selection range of this strain.

Three Punjab-American strains also supplied by Mr. Peat were discarded. All three grew poorly and the lint in all cases was poor, one strain being particularly short.

Harvesting of the various small lots is proceeding at present, and it is hoped to have a generous assortment of the strains in readiness for planting at Domira Bay this coming season. At the new station they will be subjected to jassid as well as drought, both of which Port Herald normally fails to provide.

Insect Pests.

There was marked absence of pests at Port Herald this season. Jassid and stainer have both been negligible. There was no attack of aphis as recorded in the previous year, while bollworm control by the environment has been both early and complete.

H. C. Ducker,

Cotton Specialist,

Empire Cotton Growing Corporation.

EUROPEAN AGRICULTURE.

Name of district.	Total acreage under cultivation. acres.	Tobacco		Tea.		Sisal Fibre.		Cotton.		Coffee.		Rubber.		Chillies and Capsicums.	
		Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt. (lint)	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.
Lower Shire	7,171	...	...	...	...	6,734	20,126	272	215	...	...	...	...	1	5
Chikwawa	129	40	4	...	...	...	...	50	61	...	...	...	...	..	...
Central Shire	498	338	970	...	...	...	...	4	4	30	30	..	...	...	...
Cholo	14,767	4,673	16,198	1,788	1,037	2,560	5,980	53	22	149	23	...	...	10	13
Mlanje	11,628	1,405	4,065	7,898	15,963	...	...	82	68	183	85	...	...	10	30
Blantyre	6,061	2,422	7,909	...	...	...	...	5	8	366	537	...	...	8	27
Chiradzulu	3,825	1,122	3,136	...	...	2	...	42	40	...	...	...	...	...	..
Zomba	4,292	2,485	7,806	...	...	...	...	54	64	52	13	...	...	...	...
Upper Shire	238	111	418	...	...	...	...	30	10	...	...	.	...	...	...
South Nyasa	1,956	1,443	5,199	...	...	...	...	...	...	30	7	...	...	...	...
Ncheu	2,079	1,410	4,989	...	...	...	...	70	34	346	562	...	...	5	7
Dedza	445	240	712	...	...	...	...	...	...	22	12	...	...	..	...
Fort Manning	321	260	928	...	...	...	...	2	2	2	7	...	...	...	...
Lilongwe	1,274	1,033	3,832	...	..	...	...	6	5	...	...	...	...	..	...
Dowa	537	385	1,621	..	...	...	...	26	47	...	...	...	..	...	...
Kota Kota	25	..	...	...	...	...	...	...	...	...	...	...	..	...	...
Kasungu	22	10	20	...	...	...	...	...	...	..	...	...	..	...	..
Mombera	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Nyasa	1,415	...	...	...	...	...	...	...	...	...	...	1,405	1,029	...	...
North Nyasa	442	104	397	...	...	...	...	65	55	76	10	...	...	...	...
Total ...	57,135	17,481	58,114	9,686	17,000	9,296	26,106	761	635	1,256	1,286	1,405	1,029	34	82

Name of district	Maize and Millets.		Beans.		Groundnuts.		Wheat.		Potatoes.		Miscellaneous.		Timber and Firewood.	
	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Eucalyptus acres.	Others acres.
Lower Shire	102	547	...	..	...	...	1	3	.	...	7	50	36	18
Chikwawa	7	40	30	201	...	..	..		.	. .	...	...	...	2
Central Shire	20	300	2	...	...	...	...	...	...	...	2	...	47	55
Cholo	492	7,216	692	1,773	2	7	24	188	..	...	143	327	3,845	336
Mlanje	519	5,947	305	1,321	...	...	3	10	...	...	46	17	812	365
Blantyre	583	6,408	199	158	6	3	7	14	...	...	325	836	1,925	215
Chiradzulu	356	3,481	118	277	30	341	...	...	...	...	167	332	1,918	70
Zomba	328	3,497	287	1,498	14	161	12	47	..	...	441	400	471	148
Upper Shire	50	480	42	115	...	...	...	...	...	...	...	...	1	4
South Nyasa	...	...	41	197	...	...	1	3	...	...	2	5	82	357
Ncheu	73	530	10	24	24	120	...	...	...	...	46	90	31	64
Dedza	2	40	6	23	...	...	16	87	24	561	4	4	78	53
Fort Manning ...	...	...	10	100	10	89	14	19	...	...	...	...	7	16
Lilongwe	54	440	10	33	1	2	1	1	2	20	76	73	28	63
Dowa	10	30	4	12	1	2	6	36	2	15	3	9	36	64
Kota Kota	...	...	...	...	...	...	5	30	...	...	...	...	10	10
Kasungu	..	...	3	1	1	1	..	.	...	..	...	...	3	5
Mombera	...	...	...	...	...	...	...	...	...	...	...	...	...	10
West Nyasa	...	...	...		...	...	..	..	...	..	2	...	3	5
North Nyasa	80	460	4	24	2	17	1	1	...	...	...	...	93	17
Total	2,676	29,416	1,763	5,757	91	743	91	439	28	596	1,264	2,143	9,426	1,877

NATIVE AGRICULTURE.

District.	Seed cotton.	Tobacco.
	Tons.	Tons.
Lower Shire ...	2,315	—
Chikwawa ...	2,418	—
Central Shire ...	266	—
Cholo	—	66
Mlanje ...	28	213
Blantyre ...	44	197
Chiradzulu ...	—	457
Zomba ...	—	175
Upper Shire ...	24	½
South Nyasa ...	26	1½
Ncheu ...	58	41
Dedza ...	122	152
Fort Manning ...	—	26
Lilongwe ...	—	1,762
Dowa	86	962
Kota Kota ...	—	180
Kasungu ..	—	—
Mombera ..	—	—
West Nyasa ...	—	—
North Nyasa ...	61	—
Total	5,448	4,233

NOTE.—Maize is the staple foodstuff in most districts; groundnuts, rice, wheat, beans, and various other crops are also grown by natives for local consumption, but it is impossible to make an accurate estimate of the quantities of any of these crops.

The above tobacco figures represent the quantities purchased in each district, and do not accurately reflect the production by districts, as many natives grow their tobacco in one district and sell in another.

NATIVE LIVE STOCK AT 31ST DECEMBER.

District.	Cattle.	Sheep.	Goats.	Pigs.
Lower Shire	60	1,300	9,000	5,000
Chikwawa ...	148	125	719	2,000
Central Shire	632	585	2,798	2,755
Cholo	93	440	2,389	5,475
Mlanje	100	600	4,000	3,000
Blantyre	1,043	410	2,429	2,867
Chiradzulu	1,235	4,230	583	4,694
Zomba	1,040	790	825	380
Upper Shire	37	4,030	8,853	339
South Nyasa	1,143	12,224	14,044	24
Ncheu	11,640	4,417	27,160	6,666
Dedza ...	17,957	15,500	27,000	9,500
Fort Manning	1,402	2,886	5,820	3,218
Lilongwe ...	21,476	14,000	38,000	4,000
Dowa	18,970	16,474	36,285	13,967
Kota Kota	2,289	3,196	7,709	2,123
Kasungu	3,606	4,000	3,000	—
Mombera	33,075	6,877	14,080	82
West Nyasa ...	3,349	320	1,870	—
North Nyasa	31,909	970	3,650	50
Total	151,204	93,374	210,214	66,140

LIVE STOCK OWNED BY EUROPEANS AT 31ST DECEMBER.

District.	Cows and heifers over one year	Bulls.	Oxen.	Calves.	Pedigree cattle.	Horses.	Mules.	Donkeys.	Sheep.	Goats.	Pigs.
Lower Shire	685	9	425	260	1	...	...	...	35	16	19
Chikwawa	203	10	58	83	...	...	...	14	7	...	1
Central Shire	47	3	63	10	...	...	...	2	4	...	7
Cholo	1,387	44	1,465	725	12	...	...	22	210	44	115
Mlanje	1,111	26	1,135	466	1	...	...	11	173	49	91
Blantyre	993	29	1,050	448	9	4	...	18	21	34	102
Chiradzulu	818	54	672	365	9	...	...	20	10	...	50
Zomba	1,248	27	1,350	527	17	1	1	17	326	...	30
Upper Shire	7	1	4	6	...	...	...	...	18	84	29
South Nyasa	152	10	112	75	1	...	...	1	125	164	1
Ncheu	364	11	374	147	4	...	...	2	49	69	170
Dedza	437	16	235	167	...	...	...	70	114	26	180
Fort Manning	87	2	62	21	...	...	...	...	37	...	15
Lilongwe	194	5	329	137	1	...	...	21	42	19	147
Dowa	72	1	77	51	...	...	...	...	50	...	39
Kota Kota	50	...	19	13	2	...	...	4	32	...	2
Kasungu	...	...	...	...	...	...	...	...	20	...	2
Mombera	7	1	12	1	...	...	...	...	...	...	...
West Nyasa	12	1	10	4	...	...	...	...	11	...	7
North Nyasa	142	9	210	56	...	...	...	...	92	7	41
Total ...	8,016	259	7,662	3,562	57	5	1	202	1,376	512	1,048